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Obsolete Policies in Industrial Relations

SETTLEMENT of the anthracite strike leaves one with a sense of the futility of the methods of settling industrial disputes in the coal industry. The net result is waste and loss. Neither side to the controversy has gained its original objectives and each has apparently capitulated to a vague agreement after having reached a state of exhaustion. The anthracite-using public has been greatly inconvenienced and even now can only look forward to a breathing spell of about five years, hoping meantime that intelligent leadership will develop in the coal industry.

FOR all practical purposes the miners seem to have lost their cause. After losing five and one-half months' wages they return to work under the old wage scale. Original demands for increase are abandoned. The moot check-off is not mentioned in the agreement, though indirect reference is made to it with respect to future "co-operation and efficiency"—two words strangely out of place in the industry's historic methods of settling its troubles. If the operators lost their contention for compulsory arbitration, the substitute finally agreed upon offers a distinction without much difference.

IT IS difficult to see how John Lewis can justify his course to his union followers. The best he can offer them is their old wages for the next four and one-half years, but he can offer no compensation for the net loss of the past five and one-half months. His chief quality seems to have been one of stubborn resistance for reasons of expediency. He has been a heroic figure in his role of Horatius at the Bridge; but Horatius was only a legendary figure, and according to one version was drowned in attempting to swim the Tiber after making his dramatic stand.

STUBBORN and unyielding opposition to some form of arbitration is an obsolete policy in modern human relations. With a World Court set up as a substitute for war in settling international disputes; with joint industrial committees functioning to maintain mutually satisfactory relations between employer and employee; with a federal law now effective making the awards of arbitrators enforceable in federal courts; with the general world weariness of fighting and contentious litigation; with all these evidences of the trend of modern thought and action, an uncomprising attitude against a method of referring disputes to a competent and disinterested third party is as obsolete as Sanskrit.

THE coal industry has long been a dark area in the field of industrial relations. The President said truly that it was "close to economic failure" in its inability to control its destiny. There is obvious need of new leadership that is at least abreast of the times, certainly not behind, preferably ahead. The old order has too much background of strife and dissension. The industry would be better off with new leaders, new thought and new policies.

Industry's Interest in the Return of Ethyl Gasoline

EARLY resumption of the national distribution of ethyl gasoline as a result of the favorable outcome of the Surgeon General's investigation will be welcomed by more than one of the chemical engineering industries. Eight months ago when the sale of the lead-treated fuel was voluntarily discontinued in order that an impartial investigation might be made of any possible health hazard in its use, a number of promising chemical engineering developments were held in abeyance. The recovery of bromine, successfully demonstrated on a brief trial trip of the floating factory "Ethyl" was one of these pioneering developments. Others had to do with the perfection of safety measures in a difficult phase of chemical manufacture.

The reported production, up to May 5, 1925, of one and three-quarters million pounds of pure tetraethyl lead was a considerable achievement of synthetic organic chemistry. The raw materials required in this synthesis, together with the halogen carrier and other ingredients in the anti-knock compound, held an interest for many branches of chemical industry. That these projects may now go ahead carries with it the promise not only of increased activity in our industries, but the pushing forward of the frontier of chemical knowledge in manufacture and distribution.

Gratifying as this resumption of activity is to the chemical industries, it is but incidental to the greater contribution which ethyl gasoline can make toward the solution of the ever important and increasingly complicated problem of motor fuel. Lately we have heard it said, first by the automobile manufacturer and then by the oil refiner, that the day of the high-compression motor is here and that the petroleum industry is already supplying the necessary motor fuel. Perhaps this is true to the extent that both motor and fuel have improved in efficiency over their predecessors of a year or two ago. But it is obvious, too, that this improvement has only barely started and that we can look forward to even more rapid progress in the future. The automobile manufacturer will gradually increase the efficiency of his product as the motor fuel of suitable quality and quantity becomes available.

To meet the demand for a superior fuel, the existence of which ethyl gasoline first demonstrated on a national basis, has been the outstanding effort of the petroleum industry during the past year. There has been the parallel development of benzol blends and of special gasolines of anti-knock qualities resulting either from naphthenes naturally occurring in the crude oils or from olefines and aromatics produced by cracking and special refining processes. Although adequate to meet the requirements of even the most advanced of the present-day types of motors, most of these new fuels face definite limitations for further improvement. It is here that ethyl gasoline promises to make its greatest contribution since it seems to offer the principal means for the continued improvement in fuel quality that will make possible the continued increasing of motor compression with resulting economy in design and operation.

The interest with which the subsequent progress of tetraethyl lead will be watched is more than that ordinarily accorded an industrial product. In the broadest sense this development is synthetic chemistry's first contribution toward the solution of the motor fuel problem and its success will measure the possibility for similar attack on other problems of industry.

Advancing Mr. Volstead's Boundaries of Sobriety

AS PART of the offensive directed against the Volstead Act we note with interest a joint resolution introduced in the House of Representatives "to establish a commission to investigate and determine what in fact constitutes an intoxicating beverage." What, indeed? Certainly not one-half of one per cent alcohol. Possibly three-quarters. Might the limit be cautiously set at one per cent on its upward march toward freedom and the pursuit of happiness? Perhaps if one were sufficiently bold the limit might be raised to 2, even 3 per cent, before the consumer would pass over the line from sobriety to even a mild state of intoxication. Anyhow Mr. Seger would have Congress determine the uttermost boundaries within which alcoholic beverages might be consumed with propriety. He suggests a commission of 9 members—three from the Senate, three from the House and three generously selected by the President from the general public. It is not clear whether the preponderance of members of Congress indicates superior knowledge and ability, but such is the plan. The commission is not only to have such clerical and expert assistance as it needs, but it is to have power to obtain such "supplies and equipment as may be necessary for the performance of the duties vested in the commission." Pleasant duties! One conjures up a vision of numerous and protracted sessions that might continue indefinitely, with occasional reports of progress, were it not for the unkind provision that a report of its findings must be submitted on the first day of the second session of the 69th Congress, after which the commission shall cease to exist. Expenditures are provided for in a sum not exceeding $25,000, a small sum in these Volsteadian days for any investigation of intoxicating beverages.

Corn as Raw Material for Chemical Industry

MANY forces have been mustered to the assistance of the farmer but it is only recently that the chemical engineer has been called into the councils of the strategists. This has been the indirect result of a novel campaign now under way in the Middle West for increasing the consumption of America's greatest crop. Attention has thus been focused on the chemical derivatives of corn and particularly on one of the most recent technical developments, corn sugar. This interesting material, referred to briefly on page 101 of this issue, is but one of an important group of chemical products for which corn is the common raw material.

Of a normal corn crop of about three billion bushels, at least 85 per cent is used for stock feeding. Of the remaining 450,000,000 bushels a third is usually lost by waste and deterioration, a fifth is ground into corn meal and a ninth is exported so that approximately 160,000,000 bushels is available each year for chemical uses and the production of special food products. In pre-prohibition days the whiskey distiller annually consumed 25,000,000 bushels and another 16,000,000 bushels was made into beer. That this situation has changed can be indicated in various ways, one of them being the recent report of the Commissioner of Internal Revenue which shows that in the fiscal year 1925 distilled spirits accounted for but 7,200,000 bushels while cereal beverages of the less-than-one-half-of-one-per-cent type took only 500,000 bushels from the farmers' corn cribs.

The market taken away by the eighteenth amendment, however, has been compensated to a considerable extent by the growth of the corn products industry. Starch, corn syrup, dextrose (crystallized corn sugar), corn oil and dextrine have so increased in popularity that this industry now consumes at least 75,000,000 bushels of corn each year. This growth has been more than a mere increase in magnitude. There has been increased efficiency in the recovery processes and commercial development has followed closely the progress in technology. Thus a few years ago crystallized dextrose was a laboratory product. Today there are four plants that are said to be producing a total of 500,000 lb. of this corn sugar each day. To carry on such a production for a year requires about 6,500,000 bushels of corn; and if corn sugar continues to displace the sweeter but more expensive cane sugar in the canning and preserving industries, it will become an increasingly important outlet for the farmer's surplus.

Since the war there has developed another important chemical industry for which corn is the preferred raw material. By a special fermentation process a bushel of corn can be made to yield 6 to 8 lb. of butanol, 3 to 4 lb. acetone and 1 to 1.5 lb. of ethyl alcohol. This development has already changed the status of acetone from a wood chemical to a fermentation product. And without butanol and its derivatives the commercial success of nitrocellulose lacquers would have been practically impossible. Thus the 3,500,000 bushels of corn or its equivalent in corn products that went into this industry last year paved the way for other developments of far-reaching significance.

Forced consumption of any commodity is open to question from an economic viewpoint unless the product itself has such inherent qualities that will allow it to stand on its own merits, once the artificial prop is withdrawn. Chemical products from corn are of such a character; and if the Middle West's interesting experiment in economics can help to bring about a more general recognition of this fact there are tremendous possibilities ahead for this typically American industry.

Converting an Art to a Science

ELECTROPLATING has been an art; it is due to become a science. But the transformation of this great business is not easy nor is it yet even approaching completion. Many years of investigation and much industrial development still remain ahead.

Few realize the extent to which electroplating and the electrodeposition of metals enter into all branches of industry. This lack of recognition comes largely from the fact that the cost of plating is usually a relatively small part of the total cost of manufacture of the product. Lack of appreciation has resulted in lack of support, both moral and financial, for the technical men who are responsible for the quality of plated products. Often times the skill and conscientious effort of these workers do more to determine life and satisfaction in use of the product than do the efforts of any other single group of workers concerned in its manufacture. Resistance to corrosion, resistance to abrasion and creditable appearance can be had only from good plate work. Yet the electroplater often is regarded as the least among the staff.

Of recent years the work by the American Electro-Platers' Society and the researches of the national Bureau of Standards have done a good deal to correct this unfortunate situation. The Bureau has devoted itself to a study of fundamentals in electrodeposition and has afforded the electroplaters much valuable information and instruction. The result today is a demand for knowledge far beyond that which can be found in the literature or can be afforded by the limited research facilities at the command of the industries. The foreman electroplater, until recently a believer only in rule-of-thumb, is now so thoroughly converted to the possibilities of chemical and physical control that he cannot understand why science cannot at once furnish him a solution for every mystery and difficulty.

Finding that such immediate solution was not available, he has set about remedying the lack of research by the most direct means at hand, namely the support of additional research workers in the laboratories at the Bureau of Standards. The American Electro-Platers' Society is sponsor for this effort which seeks to provide a fund of $10,000 per year for three years. The plan is to get 200 manufacturers each to contribute $50 annually for three years. A substantial number of companies have already subscribed, but the number is not yet complete.

Even the largest units in industry can rarely afford to do for themselves the needed research in electroplating because this branch of their business is but a small part of the whole. Here is an opportunity to have the work done at small expense on a sound co-operative basis, wholly in harmony with the needs of industry and by some of the ablest investigators who have ever worked in this field.

Chem. & Met. cordially commends this co-operative research which is being organized under the direction of F. J. Hanlon, chairman of the research committee of the American Electro-Platers' Society, 215 N. Jefferson St., Chicago. Whether their industries have large or small need for electroplating, we believe that executives will do well to participate in this study.

Congress Should Provide for the Fixed Nitrogen Research Laboratory

CREATED by the President, the Fixed Nitrogen Research Laboratory has been supported by funds appropriated under the National Defense Act for military preparedness. Its technical researches have contributed materially to the development of nitrogen fixation plants on a sound commercial and economic basis. Now the question arises as to the continuance of this laboratory, because the funds which have been used for its support are practically exhausted.

The Department of Agriculture, under which the laboratory now works, has wisely decided to ask Congress for the continuance of the nitrogen studies and for the granting of funds so that there may be no interruption in this important project. As there seems to be unanimous support in industrial and scientific circles for this work, there is no logical reason why approval should not be given by Congress.

The leadership of this laboratory is in able and wise hands; the technical staff is well balanced and experienced; the prospects for its work are splendid. It will be most unfortunate to allow this organization to lose morale or momentum for lack of early appropriation insuring continuance on the right basis. We bespeak for the laboratory the support of Congress and the encouragement of industrial leaders.

Measurement of Kiln Performance

How to Keep a Quantitative Check on Kiln Operation Through Gas Analyses and Other Data Easily Procurable

By W. K. Lewis and A. H. Radasch

Professor of Chemical Engineering, Massachusetts Institute of Technology, and New York State School of Ceramics, Respectively

A FEW years ago a consulting engineer was asked to investigate a new type of lime kiln and determine its performance. He tested it carefully and reported a fuel ratio, as determined from direct weighing of fuel and product, of 5.2. His report also included complete data as to temperatures, gas analyses, and the like. On the basis of his recommendation, the kiln was installed in a second plant, which, however, was never able to realize an average fuel ratio of better than 4.0. Recent study of the original report shows that the engineer failed to use gas analyses to check the direct determination of the fuel ratio. The gas analyses of the original test show a ratio of only 3.8. It seems probable that the operator succeeded in having the test start with a kiln nearly full of burnt lime that was progressively worked out during the test, winding up with a kiln nearly full of stone. Had the engineer analyzed his own data, the incompatability of the results would have been obvious and the mistake avoided. The following computations are intended to explain the technique of this sort of checking:

An externally-fired shaft lime kiln uses a coal of 14,160 B.t.u. per lb. as fired containing 78.31 per cent C, 5.26 per cent H, 1.55 per cent N, 0.90 per cent S, 6.37 per cent ash and 7.61 per cent O. The kiln burns a limestone of high purity, producing on the average 2,000 lb. per hr. of burnt lime. The average stack gas analysis is 19.1 per cent CO_2, 6.8 per cent O, and 74.1 per cent N_2. These gases leave the kiln at 300 deg. C., and the lime is discharged at 250 deg. C., air temperature being 20 deg. C.

Heat of formation of $CaCO_3$ from CaO and CO_2 at 20 deg. = 42,500 cal. per gm. mol. The sp. ht. of CaO may be taken as 0.18, while that of $CaCO_3$ is 0.202 + 0.0001 t deg., where t is in deg. C.

Compute the following:

Fuel ratio, i.e., the pounds of lime per pound of coal.

Excess air used for combustion.

Heat distribution in the kiln.

Solution.—In order to get the coal and gas analysis into more useful shape they will be recalculated as follows:

Basis: 100 lb. of coal.

	Lb.	Mols or Atoms	O_2 Required	H_2O
C	78.31	6.52	6.52	....
H_2	5.26	2.61	....	2.61
S	0.90	0.03	....	....
O_2	7.61	0.24	....	....
Net H_2	.....	2.22	1.11	....
			7.63	

Sulphur will be converted to SO_2, being absorbed by the lime as $CaSO_4$. Deducting the amount of O_2 required for this from the O_2 present gives for the net H_2, 2.61 —2 (0.24 —3/2 0.03) = 2.22 mols.

Basis: 100 mols of stack gas.

Gas	Mols	Atoms C	Mols O_2
CO_2	19.1	19.1	19.1
O_2	6.8	....	6.8
N_2	74.1	....	....
	100.0	19.1	25.9

From this table one can also compute the following:

O_2 in entering air, 74.1 (21/79)	19.7
O_2 in excess	6.8
O_2 required for complete combustion	12.9
Total C present	19.1
C from coal 12.9 (6.52/7.63) =	11.0
C from stone	8.1
Lime produced (8.1) 56.1 =	454 lb.
Coal used 11.0 (100/6.52)	169 lb.

Lb. lime per lb. coal = 454/169 = 2.68

Per cent excess air (6.8/12.9) (100) = 52.8 per cent

In computing the heat distribution, since the temperatures are all given in centigrade it will be convenient to perform the calculations in C.h.u.* rather than B.t.u.

For computing the sensible heat in the stack gas it must be remembered that this contains water vapor. The fuel analysis shows 2.61 mols of water for every 6.52 atoms of carbon and the gas analysis, 11.0 atoms of carbon from the coal. Consequently there will be 11.0 (2.61/6.52) = 4.41 mols of water vapor for every 100 of dry stack gas.

Basis: 100 mols of dry stack gas.

Gas	Mols	Heat Content at 300 Deg.	Heat Content at 20 Deg.	Difference = Sens.Ht./ Mol	Sens. Ht. Total
CO_2	19.1	2,920	180	2,740	52,400
N_2,O_2	80.9	2,070	140	1,930	156,000
H_2O	4.41	2,530	170	2,360	10,400
Total	104.41				218,800

This and the other items of heat output will be calculated per hour.

Basis: 1 hour	C.h.u.	Per Cent
Stack gas loss per hour		
(218,800/454) (2,000) =	964,000	....
(964,000/5,650,000) (100) =	.....	17.0
Heat in lime,		
(2,000) (0.18) (250-20) =	82,000	....
(82,800/5,650,000) (100) =	.....	1.5
Heat of decomposition,		
(2,000/56.1) (42,500) =	1,515,000	....
(1,515,000/5,650,000) (100) =	.....	26.8
Total heat accounted for	2,562,000	45.3
Heat loss by radiation, by diff.	3,088,000	54.7
Total heat output = heat input	5,650,000	100.0

The mols of gas passing thru the shaft per lb. of lime produced = $\frac{104.41}{454} = 0.23$

*Heat required to raise one pound of water one degree centigrade.

The heat of combustion of the coal is 14,160/1.8 = 7,870 C.h.u. per lb. which is the higher heating value. Since the water of combustion will be vaporized this should be lowered by that amount. Using 10,500 C.h.u. per mol of water this will give 7,870 — 10,500 (2.61/100) = 7,595 C.h.u. Thus the heat input will be the number of pounds of coal times the lower heating value (2,000/2.68) (7,595) = 5,650,000 C.h.u.

The heat output is made up of the sensible heat in the stack gas, the sensible heat in the hot lime, the heat of decomposition and the radiation loss.

It is proposed to provide the kiln of the preceding problem with Eldred-Doherty recirculation to reduce fuel consumption and to protect the lime from overburning. To accomplish this, the kiln will be operated with only 20 per cent excess air and the recirculation and furnace operation so adjusted that the furnace gases enter the kiln at 1,100 deg. C. Furthermore, these furnace gases entering the kiln are to contain enough CO and H_2O so that their heat of combustion will furnish the total heat of decomposition of the stone at burning temperature. The lime is to be burnt at 900 deg. C. All preheating of the stone will be done at the expense of the sensible heat of the kiln gases. No attempt will be made to increase kiln capacity. This being the case, one may safely assume the same temperature for stack gases and burnt lime as under present operating conditions, i.e., 300 deg. and 250 deg. C. respectively. Furthermore, wall losses by radiation and conduction will remain unchanged. It is estimated that of these total wall losses, 5 per cent occur in the cooling zone, 10 per cent in the lime burning zone, 15 per cent from the external furnace and 70 per cent from the charge preheating zone in the upper part of the shaft and stack connections.

These assumptions appear to imply a sharp demarcation between the zones of preheating and burning the stone, whereas of course these zones overlap decidedly. However, such overlap does not affect the heat distribution on the assumptions as stated. Actually some residual CO and H_2 may burn in the preheating zone but in so far as this is the case the gases cool correspondingly in decomposing the stone. Effects of this sort must counterbalance completely and therefore need not be considered in computation.

The molal ratio of CO to H_2 in the furnace gases may be taken as 4 to 1. Even if this ratio were greatly in error it makes but little difference because the heats of combustion of the two are so nearly equal.

To design the recirculating equipment one must know the amount of gas to be handled and to justify the installation, the saving in fuel. We will compute (1) the percentage saving in fuel which may be anticipated from the modified equipment, (2) the volume of stack gases which must be recirculated per hour, (3) percentage of the total air supply which enters the furnace and percentage entering the bottom of the kiln as secondary air, and (4) analysis of the furnace gases entering the kiln.

Solution.—Examination of the problem shows that the data given are the coal analysis, the amount of lime produced, the per cent excess air, certain temperature requirements, certain physical characteristics of the materials such as specific heats and heats of reaction, and the radiation loss. The problem then involves several unknown quantities. One of these is the fuel consumption which we will call x. Now the total air used is a function of x and so also is the quantity of stack gas. An overall heat balance will give the value for x. The fact that some gas is recirculated does not influence the gas analysis. For as a certain amount of the gas enters the furnace at 300 deg., a like amount is discharged from the top of the kiln.

Therefore, consider a section around the whole kiln. Then, the streams entering this system are the coal, the air and the stone while the streams of materials leaving are the lime and the waste gas.

Basis: 1 hour. The heat input to the system is 7,595x C.h.u. The heat output consisted of the stack loss, the sensible heat in the lime, the heat of decomposition and the radiation loss. The last three items remain the same as in the previous case but the stack loss is different. Upon formation of 2,000 lb. of lime there will be evolved 2,000/56.1 = 35.7 mols of CO_2. The tabulation of the coal analysis given above shows the amount of CO_2 and H_2O formed and of oxygen required for combustion. The combustion products are:

Source	CO_2	O_2	N_2	H_2O
Stone	35.7	.....	.....	.....
Coal	0.0652 x	.....	.....	.....
Theor. air	.....	.....	(0.0763 x) (79/21)	0.0261 x
Excess air	.....	(0.0763 x) 0.2	(0.0763 x) (0.2) (79/21)	.....
Total	35.7+0.0652 x	0.0153 x	0.3442 x	0.0261 x

The stack loss is the sum of the products of the mols of these gases into the respective heat contents between 20 deg. and 300 deg., calculated as before, giving (35.7 + 0.0652x) (2,740) + (0.3442 + 0.0153) (x) (1,930) + (0.0261x) (2,360) = 97,900 + 934x.

The heat balance may now be written using the values for the heat of decomposition, heating of lime and radiation loss as before, 7,595x = (97,900 + 934x) + 82,800 + 1,515,000 + 3,088,000, giving x = 718 lb. of coal.

With the present installation, the fuel consumption per hour is (0.372) (2,000) = 744 lb. This means a saving of 26 lb. or of (26/744) (100) = 0.35 per cent. Consequently if the installation be justified, it must be on other grounds than the saving in fuel.

Since 718 lb. of fuel will be required one may now go back and find the amount of waste stack gas and its composition.

	Function	Amount (x=718)	Fraction	Per Cent
CO_2	35.7+0.0652 x	82.6	82.6/341.6	24.2
O_2	0.0153 x	11.0	11.0/341.6	3.2
N_2	0.3442 x	248.0	248.0/341.6	72.6
		341.6		100.0
H_2O	0.0261 x	18.75		
Total noted burned gas		360.35		

The composition of the recirculated gas is the same as the waste gas given in the last column.

In the top of the kiln, this waste gas and the recirculated gas must lose enough heat in dropping in temperature from 1,100 deg. to 300 deg. to preheat the charge to 900 and furnish 70 per cent of the total radiation loss. The following table shows the fraction of the heat supply contained in the waste gas.

Gas	Mols	Heat Content at 1,100	Heat Content at 300	Difference = Heat Loss/Mol	Mols × Diff. = Total Loss
CO_2	82.6	12,500	2,920	9,580	792,000
O_2, N_2	11.0+248	8,150	2,070	6,080	1,577,000
H_2O	18.75	9,840	2,530	7,310	137,000
	360.35				2,506,000

This is a heat loss of 2,506,000/360.35 = 6,960 C.h.u. per mol of gas per hr. The remaining calculations may be indicated as follows:

Av. sp.ht. limestone, 20 deg. to 900 deg. 0.202 + 0.0001 (920+20)/2 = 0.248	.....
Heat required to preheat limestone, (2,000) (100.1/56.1) (0.249) (900–20) =	779,000 C.h.u.
Heat loss by radiation in preheating zone and corrections (70 per cent of total radiation loss) (0.70) (3,088,000) =	2,162,000 C.h.u.
Total heat requirement	2,941,000 C.h.u.
Furnished by waste gas	2,506,000 C.h.u.
Furnished by recirculated gas	435,000 C.h.u.

Mols recirculated gas (435,000) (360/35/3/2,506,000) = 62.8.
This is of course the total recirculated gas including water vapor. Its volume is found to be (62.8) (359) (573/273) = 47,400 cu.ft. per hr. at one atm., and represents

$$\frac{62.8 \times 100}{62.8 + 360.35} = 14.8 \text{ per cent of the total stack gas.}$$

The mols of gas passing through the charge per lb. of lime produced

$$= \frac{423.15}{2{,}000} = 0.21$$

It is now required to find the distribution ratio between primary and secondary air. The total air is known to be 20 per cent in excess of that theoretically required.

The amount was indicated when the fuel requirement was computed. There it was shown that 248 mols of nitrogen were used. This would mean (248) (100/79) = 314 mols of air. The calculation of the amount of either the primary or secondary air will obviously give the ratio of one to the other. Insufficient data are given concerning the secondary air entering the bottom of the kiln but the amount of primary air entering the furnace can be determined by using a heat balance on this part of the kiln.

The heat input in this zone is the heat content of the recirculated gas plus the heat of combustion of the coal, corrected for any carbon and hydrogen not burning to CO_2 and H_2O.

It has been shown that the heat content of the waste gas above 20 deg. was 97,900 + 934x for 340.35 mols, or, since x equals 718, 767,900 C.h.u. Therefore the heat supply of 62.8 mols is 767,908 (62.8/360.35) = 134,000 C.h.u.

If the mols of carbon burning to CO is y the mols of hydrogen present as such in the furnace gas will be $y/4$. The lower heats of combustion of CO and H_2 are 68,000 and 58,000 respectively. Consequently, the net heat of combustion of the coal is (7,595/718) — 68,000y — 58,000 ($y/4$). The total heat input to the furnace is 134,000 + (7,595) (718) — 68,000y — (58,000) ($y/4$) = 5,584,000 — 82,500y.

This heat is used to heat up the reaction products, CO, H_2, H_2O, and N_2 (there being no O_2) to 1,100 deg. and furnish 15 per cent of the radiation loss. To compute the sensible heat in the products of combustion one must first know their amounts. Their source is recirculated gas, coal and air. The following table is based on the coal analysis and the amount and composition of the recirculated gas and should be self-explanatory:

Total carbon in gas (CO + CO_2), 0.0652 (718) + 62.8 (82.6/360.35) =	61.2 atoms
Total hydrogen in gas (H_2O + H_2), 0.0261 (718) + 62.8 (18.75/360.35) =	22.02 mols
Carbon as CO	y mols
Carbon as CO_2	61.2-y mols
Hydrogen as H_2	$y/4$ mols
Hydrogen as H_2O	22.02-$y/4$ mols
Oxygen required, $y/2$ + (61.2-y) + (22.02-$y/4$)/2 =	72.2–0.625 y mols
Oxygen from recirculation gas (62.8/360.35) (82.6 + 11.0 + 18.75/2) =	17.80 mols
Oxygen required from air	54.4–0.625 y mols
N_2 from air, (54.4–0.625y) 79/21 =	204.7–2.35 y
N_2 from recirculated gas 62.8 (248.0/360.35) =	43.2
Total N_2	247.9–2.35 y

The sum of the diatomic gases is, $y + y/4 + 247.9 - 2.35y = 247.9 - 1.10y$

The sensible heat content of the gases are given below

Gas	Heat Content at 1,100 Deg.	Heat Content at 20 Deg.	Difference = Sens. Heat/Mol
CO_2	12,500	180	12,320
N_2, H_2, CO	8,150	140	8,010
H_2O	9,840	170	9,770

and the sensible heat of the gases, (61.2–y) (12,320) + (247.9–1.10y (8,010) + 22.02–$y/4$) (9,770) = 2,954,000 — 23,570 y
This radiation loss is 0.15 (3,088,000) = 463,000
Equating heat input to heat output gives an equation with y, namely, 5,584,000 — 82,500 y = 2,954,000 — 23,570 y + 463,000 which, when solved, gives y = 36.3.

If the oxygen required by the primary air is 54.4–0.625 y, then the primary air is (54.4–22.7) (100/21) = 151 mols.
This is 48.0 per cent of the total of 314 mols required whence the secondary air is 163 mols or 52.0.

The heat liberated by combustion of the coal in the furnace = 7,595 × 718 — 68,000 × 36.3 —58,000 × 36.3/4 = 2,452,000 C.h.u. which is

$$\frac{(2{,}452{,}000)\ (100)}{(7{,}595)\ (718)} = 45 \text{ per cent of the total heat of combustion of the fuel.}$$

Knowing y to be 35.9 one can find the composition and amount of the furnace gas.

Gas	Function	Mols	Fraction	Per Cent
CO_2	61.2–y	24.3	24.3/227.8	10.7
CO	y	36.9	36.9/227.8	16.2
H_2	$y/4$	9.2	9.2/227.8	4.0
O_2	247.9	157.4	157.4/227.8	69.1
Total dry		227.8		100.0
H_2O	22.02–$y/4$	12.8		
Total wet		240.6		

As a final check on the system, the temperature to which the secondary air is preheated should be calculated. The heat taken up by the air is equal to that given up by 2,000 lb. of lime in cooling from 900 deg. C. to 250 deg. C. or (2,000) (0.18) (900 — 250) = 234,000 C.h.u. There are 165 mols of secondary air, which, by trial, will be heated to 230 deg. C.

The following table exhibits a comparison between the quantitative behavior of the kiln with and without the recirculation system:

	Without	With
Lb. lime produced, per hr.	2,000	2,000
Lb. lime, per lb. coal	2.68	2.78
Per cent excess air	52.8	(fixed) 20.0
Coal used, lb.	744	718
Mols gas thru lime, per lb. lime	0.23	0.21
Per cent stack gas recirculated	0.0	14.8
Cu.ft. stack gas recirculated, per hr.	0.0	47,400
Per cent lower heating value of coal lost up stack	17.0	14.1
Per cent lower heating value of coal in sens. ht. of lime	1.5	1.5
Per cent lower heating value of coal used to decompose lime	26.8	27.8
Per cent lower heating value of coal to radiation, etc.	54.7	56.6
Per cent lower heating value liberated in furnace	100.0	45.0

From the results obtained it can readily be seen that the advantages of the Eldred-Dougherty recirculation system lie, not in fuel saved nor in lower costs of operation, but in the higher quality and greater uniformity of the product.

Relation of Heating Value of Gas to Its Value to the User

This summary of the recent technologic paper of the Bureau of Standards presents the Bureau's findings on this moot question

By E. R. Weaver

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ANYONE who takes the trouble to read in detail the direct evidence regarding the usefulness of various qualities of gas can arrive at only one conclusion. For all ordinary purposes, the value of commercial gases, not containing too large a quantity of inerts, is directly proportional to their heating value.

The data that have an important bearing on this subject are of two kinds: the direct observation of the useful effect that may be obtained by burning gases of different heating values in representative appliances; and the amount of gas burned by all the customers of a gas company, or by a selected group of customers before and after the heating value of the gas has been changed.

The amount of potential heat purchased at a given price is the only thing with which the user is concerned; all the other properties of the gas, including volume, are unimportant. The proof of these statements rests upon several thousand careful determinations made by not less than fifty observers taking part in more than a score of independent investigations upon appliances of every general type in common use, and upon some of the less common industrial appliances. There is no evidence of any importance that in any part of the range of commercial gases there is any considerable advantage in thermal efficiency for the gases of lower heating value. Some of the minor variations of efficiency which are reported are no doubt caused by the computation of efficiency from "total" or "gross" heating value instead of from the "net" heating value which is the real measure of the heat produced when the gas is burned.

The statistical data relating to consumption naturally are more difficult to interpret than the results of direct tests because the volume of gas sold is subject to many conditions other than its heating value. Nevertheless, when the groups considered are not too small, and when they are studied over a sufficiently long period of time, it is in most cases very apparent that the volume of gas used has varied nearly, if not exactly, in inverse proportion to the heating value. That is, changes of heating value do not greatly affect the amount of heat used by a community.

There is in nearly every community a seasonal variation in the use of gas. By comparing a year in which a change of heating value took place with another year, any seasonal variation common to the two years can be eliminated. Similarly, by comparing the use of gas in two communities, in only one of which the heating value was changed, conditions common to the two localities can be eliminated. If the necessary data are available, it is always of advantage to compare several years and several localities. By applying these methods, it is possible in many cases to determine a pretty definite quantitative relation between the change of heating value and the change of consumption which resulted from it.

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Summarizing Quantitative Data

In order to summarize the quantitative data of this kind, we will designate by R the ratio of the change of volume used, which accompanied a change of heating value, to the change of volume which would have corresponded exactly to inverse proportionality between heating value and volume.

R is defined mathematically as follows: Let us represent by H the heating value of the gas before the change, by h an increase, and by $-h$ a decrease in the heating value; by V the volume of gas used by the community or group under consideration, and by v the increase in the volume used which accompanies the change of heating value. Then R may be defined by the equation

$$R = \frac{-Hv}{h(V+v)}$$

If no change of the volume of gas used by the community appears to have resulted from the change of heating value, $R = 0$; if no change of the heat used appears to have resulted, $R = 1.0$.

The meaning of R and the way in which it is determined may be made clearer by an example. The heating value of the gas distributed in Seattle in August, 1920, was 1.082 times the average heating value of the gas distributed during August of 1917, 1918, 1919, 1921, 1922 and 1923. The average heating value of the gas distributed in December of 1920 was 0.894 times the average heating value during December of the other six years. The average volume used per meter within the city in August, 1920 was 0.947 times the average volume used per meter during August of the other years. The average volume used during December of 1920 was 1.113 times the average for the other six years. In our formula for R,

$$H = 1.082$$
$$h = 0.894 - 1.082 = -0.188$$
$$V = 0.947$$
$$v = 1.113 - 0.947 = +0.166$$
$$R = \frac{1.082 \times 0.166}{0.188 \times 1.113} = 0.86$$

The meaning of R will become clear from the following considerations. The amount of potential heat used by the average customer in August of 1920 was $1.082 \times 0.947 = 1.024$ times that used by the average

customer during the same month of the other six years. The amount of potential heat used in December of 1920 was $0.894 \times 1.113 = 0.996$ times that used in other years. Had the change of heating value (or other unusual circumstances occurring during the months August-December) had no effect upon the amount of heat used the ratio would have been 1.024 for December as well as for August; but had there been no effect upon the volume used, the ratio of volumes would have remained 0.947 instead of increasing to 1.113. The increase $1.113 - 0.947 = 0.166$ is 86 per cent ($R = 0.86$) of the increase which would have been necessary to maintain a constant ratio for the potential heat used.

It should be noted that the value of R is unaffected by the general increase in the use of gas (13 per cent) taking place during the period studied or by seasonal variations in so far as these changes were regular and repeated themselves from year to year. The actual increase in the volume of gas used per meter per month from August to December was about 24 per cent, but only about half of this increase is peculiar to 1920 and occurs in the computation of R.

The table gives the values of R obtained in every case studied in which it seemed possible to arrive at a definite figure. Some of the data discussed in the Technologic Paper of the Bureau of Standards covering this point are not included in this table because their irregularity or short duration make any quantitative relation uncertain. Among them are at least as many cases in which more heat was used after a reduction of heating value as there are cases in which less heat was used.

The rule that the same service is obtained from the same amount of heat is found to apply very generally to all sorts of appliances and to all kinds of gases; it should be possible, therefore, to give a general explanation of the reason why efficiency in use is not more dependent upon properties of the gas other than the total heat supplied. It makes little difference, however, whether the explanation which is here offered is or is not correct; the observed facts which it covers have been thoroughly established independently of any explanation or theory whatever.

Why Heating Value Is the Criterion

The key to the explanation lies in the fact that when any of the commercial combustible gases (containing not too large a quantity of inerts) is burned with air under favorable conditions, the hottest part of the flame has about the same temperature for each gas. (This is not necessarily the "theoretical flame temperature" obtained by dividing the heating value by the specific heat of the products of combustion.) In a few applications, all the heat of the gas is directly utilized. In all others there is an incomplete transfer of the heat of the combustion from the flame to some object to be heated, and the efficiency of the transfer depends upon bringing the zone of maximum flame temperature into the most favorable position with respect to the object. When this is done, i.e., when the appliance is correctly adjusted, the rate of heat transfer from the flame to the object will be independent of any condition which does not change the total amount of heat supplied to the region of transfer.

In some applications, most notably the cutting and welding of metals with a blow torch, the region of heat transfer is small and the amount of heat dissipated is large so that it is necessary to supply heat at a very rapid rate to a small area. In this case the gases which react most rapidly (hydrogen and some of the hydrocarbons) are most valuable; and the possibility of supplying heat more rapidly to a given area probably makes hydrogen of a little more value for many purposes than in proportion to the heat it produces (which is the net value). However, the existing data indicate that this advantage of hydrogen is seldom great enough to make the rapidly burning gas of as great relative usefulness per unit volume as would correspond to its total heating value; and the ratio of usefulness of gases for most purposes, therefore, seems to lie between the ratios of their total and net heating values.

The possibility of using the greater reaction velocity of hydrogen is limited in many appliances by the danger of flashback; this is especially true in the case of radiant heaters and mantle lights where the rapid reaction of hydrogen might otherwise prove important.

The correctness of the above explanation rests upon the correctness of the statement that "when any of the commercial combustible gases is burned with air under favorable conditions the hottest part of the flame has about the same temperature for each gas." There are in the technical literature several discussions of this subject based upon more or less theoretical grounds (involving the relation between flame velocities, specific heats, the potential heat per unit volume of the gas-air mixtures in correct proportion for complete reaction,

VALUES OF "R"

R is the ratio of apparent percentage change of consumption to the percentage change of heating value which causes it. When $R = 1$, it indicates that the total heat used was the same regardless of heat per cubic foot.

Case Considered	Approximate Number of Customers	Time Considered	Changes of Heating Value: Number	Changes of Heating Value: Magnitude of Largest Per Cent	Value of "R"	Note
Intercomparison between Fresno, Los Gatos and San Jose	32,000	3 yrs.	6	−12.6	1.3	
14 restaurants in Santa Barbara	14	8 weeks	1	+27.3	1.0	A
Intercomparison of 57 companies of Massachusetts in 3 groups	620,000	4 yrs.	3	− 4.2	1.2	..
Intercomparison of 57 companies of Massachusetts in 3 groups	620,000	7 yrs.	6	− 4.2	1.4	..
Comparison of Lawrence and Lowell	55,000	4 yrs.	1	− 4.8	1.3	..
62 industrial customers of Reading, Pa	62	2 yrs.	1	− 3.3	0.9	..
14 industrial customers of Reading who did not change their equipment	14	8 months	1	− 8.0	0.6	..
Prepayment meters in Reading, Pa	.....	18 months	1	− 8.0	0.7	..
Sheboygan, Wis	5,000	16 months	1	−10.0	1.0	..
Providence, R. I	67,000	4 yrs.	1	−12.0	1.0	..
Seattle, all customers	50,000	7 yrs.	1	−19.0	0.9	B
Seattle, residential customers	2,873	7 yrs.	1	−19.0	1.0	B
Spokane, all customers	9,000	7 yrs.	1	−14.0	1.0	C
Spokane, residential customers	210	7 yrs.	1	−14.0	1.0	..
Tacoma, all customers	12,000	4 yrs.	1	−19.0	0.8	B
Philadelphia	417,000	4 yrs.	2	−20.0	0.6–0.9	D

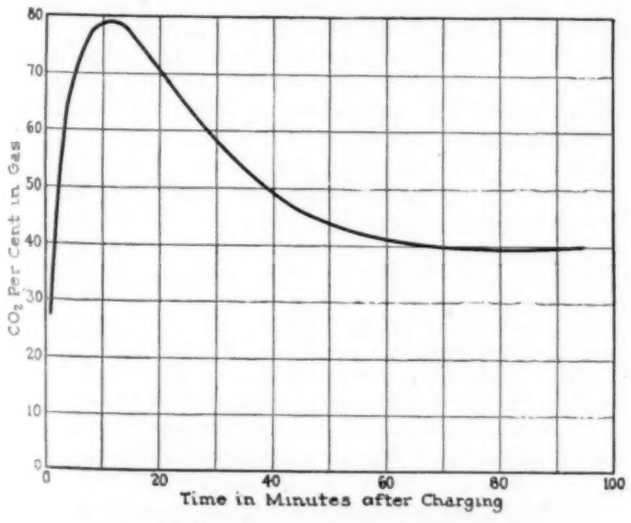
Notes: A—Santa Barbara is interesting as our only case of a large increase of heating value.
B—Economic conditions known to have been unfavorable to the change of volume used which the change of heating value would produce.
C—Average of figures including and omitting December, which appeared to be abnormal. See discussion in Technologic paper.
D—This value for R, which is difficult to determine because the change was made gradually at a time when other conditions were changing rapidly, is the estimate of the Philadelphia "Gas Commission."

dissociation at high temperatures, etc.). Few if any of these discussions take complete account of all factors involved; and in view of the uncertain accuracy of some of the important data such as the specific heats of gases at high temperature, we are justified in avoiding the complication and uncertainty of a theoretical discussion by considering only directly observed facts.

The behavior of the mantle light is of the utmost importance in this connection because the mantle will glow with maximum brightness when it coincides with the hottest part of the flame, and the brightness of the mantle affords a delicate measure of the relative temperatures of the combustion zone under various conditions. The observations of the efficiency of gas when used for mantle lighting have been more complete than for any other purpose; and they have consistently shown the relation that, when the volume of gas and air is adjusted to bring the mantle into the region of maximum temperature, the mantle glows with equal brightness when supplied with equal amounts of heat regardless of the heating value of the gas.

The observations of the efficiency of gas when used for mantle lighting have this significance in connection with the behavior of other appliances: The mantle light is the appliance in which the products of combustion leave the zone of useful application at the highest temperatures. It should be the first appliance to show the effect of flame temperature upon the efficiency with which the same total heat is applied. And when no such effect appears we would naturally expect that it would not appear in other appliances less sensitive to the conditions of application of the heat evolved. As a matter of fact, it does not appear in any of the many classes of appliances which have been investigated except the blow torch.

In conclusion, it is stated that a careful review of both the direct observations upon the use of gas for various purposes, and of statistical data relating to changes of the volume of gas used which accompany a change of heating value, shows the evidence to be in general agreement. Both classes of data lead to the definite conclusion that the usefulness of gas to the consumer is directly proportional to its heating value. No advantage to the consumer can result from a decrease of the heating value of the gas unless the price is lowered more than in direct proportion.



Curve Showing Concentration of CO_2 in Gas from Seaweed Carbonization

Carbonization of Seaweed

Thermal side of the retorting of this material for recovery of iodine and potassium studied by the British Fuel Research Board

By C. H. S. Tupholme
London, England

TO DETERMINE the possibilities attached to the utilization of seaweed by carbonization, with the view of providing employment in the more remote parts of Great Britain and Ireland, the British Fuel Research Board has completed a series of trials bot hon small and large scale apparatus, the seaweed beaing carbonized inhorizontal gas retorts at 600 deg. C.

That the old system of "kelp-burning" could be improved upon was demonstrated by Stanford around 1870, who obtained the following comparative figures per ton of air-dried weed:

	Kelp Process	Carbonization Process	Extraction Process
Kelp	3.6 cwt.	.....	.....
Charcoal	.....	7.2 to 8 cwt.	.....
Salts	1.8 cwt.	3 cwt.	4.2 cwt.
Iodine	3 lb.	7 to 8 lb.	6 to 8 lb.
Moisture, per cent			7.8

Stanford carried out his carbonization process in an iron retort.

The British Fuel Research Board, in their investigations along the lines indicated by Stanford, carried out their tests on samples of mixed *Laminaria*, obtained from the Irish coast, the bulk consisting of cut weed, the stipes being from 6 to 8 in. in length. After preliminary tests on a small scale the weed was carbonized in large horizontal gas retorts in such a way that all the liquid products could be collected. The temperature of the retort before charging was 600 deg. C., and the full charge of 40 lb. was introduced on two iron trays. The gas liberated at first was very high in carbon dioxide and was allowed to escape. As soon as it was capable of burning against a flame the escape was closed and the gas passed into a holder. This point was reached about 30 min. after charging, when the carbon dioxide content had fallen to 67 per cent. Carbonization was continued for a further 1½ hours, when gas evolution had practically ceased. The yields are shown below, both as weighed and as calculated per ton of dry weed:

Weight of seaweed charged	40/lb.
Moisture per cent	7.8

Yields on Carbonization at 600 Deg. C.

	As Weighed	Per Ton of Dry Weed
Solid residue	14.8 lb.	8.00 cwt.
Tar, D.15/15 = 1.048	3.1 lb.	17.7 gals.
Liquor, D.15/15 = 1.037	13.4 lb.	59.8 lb.
Gas, total	88.7 cu.ft.	5,400 cu.ft.
Gas, combustible	26.0 cu.ft.	1,582 cu.ft.
Ammonium sulphate	8.8 oz.	33.6 lb.

The analysis of the combustible gas was as follows:

CO_2	38.5
C_nH_m	5.3
O_2	0.4
CO	10.6
H_2	13.0
C_nH_{2n+2}	27.5
N_2	4.7
	100.0

Gross calorific value.....557 B.t.u. per cu.ft.

The variation of the carbon dioxide content from beginning to end of the carbonization is shown in the graph. The percentage is so high that even water-scrubbing alone would remove a considerable amount of it and reduce the amount of inflammable gas lost in the preliminary blow-off.

The seaweed tar as collected was a black, viscous, strong-smelling liquid with a specific gravity at 15 deg. C. of 1,048, dry. A sample was subjected to fractional distillation, the fractions being washed with sulphuric acid and caustic soda. The fractions were as follows:

Fraction	S.G. 15 Deg. C.	Per Cent of Tar by Vol.	Yield per Ton of Dry Seaweed
1. To 200 deg. C.	0.885	14.0	2.48 gal.
2. 200–250 deg. C.	0.954	20.9	3.70 gal.
3. 250–300 deg. C.	0.978	16.2	2.87 gal.
4. 300–315 deg. C.	.....	12.8	2.27 gal.
5. Pitch	1.173	35.5	73.70 lb.

The yields of the washed fractions are shown below together with the distillation ranges of those fractions which were separated in sufficient quantity:

					Total Yields—	
Fraction	1.	2.	3.	4.	As Per Cent of Tar	As Gal. per Ton of Dry Weed
Caustic soda extract	11.0	26.0	16.0	20.0	12.2	2.16
Sulphuric acid extract	16.0	18.0	26.0	8.0	11.2	1.98
Residual oil	73.0	56.0	58.0	72.0	40.6	7.20

In order to determine the amount of alkali salts and iodine recoverable, three samples were carefully analyzed: (1) the average sample of dry weed; (2) the carbonaceous residue resulting from carbonization in horizontal retorts, and amounting to 40 per cent by weight of the dry weed; (3) the ash obtained by incinerating at 500 deg. C. the above carbonaceous residue. This ash represented 24.2 per cent of the dry weed.

The analysis of these various products and of the salts obtained are shown below:

Dry Seaweed

	Per Cent
Ash	25.50
Soluble salts	18.10
Potassium	4.25 or 8.10 KCl
Iodine	0.40 or 0.47 NaI
Sulphate as SO_3	1.94 or 3.44 Na_2SO_4

Charcoal (40 per cent of dry weed)

	Per Cent
Carbon	35.74
Ash	64.26
Soluble salts	45.56

Charcoal After Extraction (21.78 per cent of dry weed)

Carbon	65.70 per cent
Calorific value	9,500 b.t.u. per lb.

Ash (24.2 per cent of dry weed)

	Per Cent
Carbon	5.60
Soluble salts	71.92

The soluble salts extracted from the charcoal and ash were next analyzed, and gave the following results. Analyses by Stamford of salts obtained from *Laminaria stenophylla* and *Fucaceae vesiculosus* are also given for purposes of comparison:

	Soluble Salts from		Stanford	
	Ash	Charcoal	L. Stenophylla	F. Vesiculosus
K_2SO_4	28.1	22.9	9.72	23.62
KCl	23.8	24.2	31.79	13.71
NaCl	33.4	35.6	48.67	56.20
$MgCl_2$	0.2	0.2	5.74	.....
$CaSO_4$	.....	.....	1.93	4.33
Na_2CO_3	9.4	12.7	.....	.....
NaBr	1.8	1.9	.....	.....
NaI	2.0	2.5	1.79	0.12
	98.7	100.0	99.64	99.98

The most prominent difference between these salts and those of Stanford is the presence of carbonates in considerable quantity. This, in the opinion of the Fuel Research Board, is probably due to the temperature of decomposition being carefully controlled so that at no time was the ash overheated. In this case 600 deg. C. seems to have been the possible upper limit, as a special test showed that a rise of 59 deg. C. resulted in fusing and slagging of the mass.

The Fuel Research Board comes to the conclusion that a carbonizing plant for the destructive distillation of seaweed would depend largely for its success on the possibility of making the process thermally self-contained, as the possibility of obtaining some cheap fuel is remote except in those districts where peat is available. It is necessary therefore to consider whether or not the available heat units in the byproducts could be sufficient, if properly applied, to carry on the process.

The devising of a suitable retort for the carbonization of seaweed is complicated by two outstanding difficulties: The large amount of water which must necessarily be evaporated from the weed; and, secondly, the comparatively low bulk density of even dried weed. The first of these difficulties can be overcome to some extent by preliminary air-drying, but this is always a slow process and in a carbonizing system would probably have to be accelerated.

The settings, said the Board, could readily be made of the type of horizontal gas retorts, but with cast iron retorts and charging doors. Each retort would require, unless lime purification of the gas could be employed, a second gas off-take pipe to admit of the first rush of gas rich in carbon dioxide. When this had escaped, the combustible gas could be collected in the usual way and used for heating the retorts. According to the results obtained in these tests, a bench of 10 retorts of about 15 cu.ft. capacity each would be capable of carbonizing 5 tons (dry weight) of air-dried weed (15 per cent water) per 24 hours, assuming a charging interval of 3 hours per retort.

The heat units available in the byproducts to carry out this carbonization would be as follows:

Therms (of 100,000 B.t.u. each)

Gas	65
Charcoal (after extraction of salts)	232
Tar	118

The heat available in the gas would probably be sufficient for carbonization, provided fairly dry weed could be guaranteed. If it could not, the drain of heat caused by the evaporation of the additional water would soon render the gas made insufficient to maintain a good working temperature. If it is assumed that the air-dried weed contains 15 per cent moisture, the heat required per day for the evaporation of the water alone would amount to over 20 therms, leaving less than 45 therms to carbonize the weed and make good the radiation losses. As 15 per cent is probably the lowest figure to which the water in seaweed can be reduced by air-drying alone, the importance of reducing the actual amount present when carbonized is very evident. If the therms in the gas were insufficient they could be assisted by burning the extracted charcoal or the tar, though the latter might find some more profitable commercial application. The therms in the charcoal could be utilized in the air-drying of the weed before charging in the retorts.

To sum up, the yields obtained per ton of air-dried weed in gas retorts at 600 deg. C., were:

Charcoal	8.00 cwt.
Tar	17.70 gal.
Liquor	59.80 gal.
Gas	5,400 cu.ft.
Gas	Over 8.6 therms (of 100,000 B.t.u. each)

The results on the whole confirm the work that Stanford carried out from 1870-90, and indicate that the subject might repay work on a larger scale.

Factors in Chemical Plant Location

Success of proposed enterprise may hinge on consideration of raw material and power sources, markets, labor supply and transportation facilities

By Chaplin Tyler
Assistant Editor, *Chem. & Met.*

OF THE many factors that play a part in plant location, it is conceded generally that the following are fundamental irrespective of the exact nature of the enterprise: (1) source of raw materials, (2) market for finished products, (3) source of fuels and power, (4) source of labor, (5) transportation facilities, and (6) economic relation to other industries. In no two industries are the foregoing factors likely to have equal weight; in fact, it will develop that the widest variations occur and therein lies the desirability of studying thoroughly each individual problem in plant location.

1. Source of Raw Materials.—When tonnage is high and bulk value low, the source of raw materials is certain to be of first importance in plant location. The classic example is the iron and steel industry, which both in this country and in Europe has been located with quantitative precision. Three basic raw materials, iron ore, coal and limestone, are necessary; and as these may not occur contiguously, a hypothetical center of all the raw materials is determined for purposes of calculation. Other examples in which the source of raw materials is a big factor are the cement, lime, clay products, salt, acid phosphate, pulp and paper, beet sugar, coke byproducts, copper smelting, shale oil and wood distillation industries.

Obviously, physical distance to the source of raw materials is not always controlling as it is necessary to compute the ultimate raw material cost at the plant on a number of component factors, such as (1) purchase price at source, (2) buying expense, (3) freight charges, (4) reserve stock necessary to offset irregularities of supply, and (5) reliability of supply.

2. Market for Products.—Usually this factor is equal in importance to that of raw material supply. In fact, the location of a small plant generally is determined entirely by market considerations. Thus the higher production cost of the small plant is offset by low freight charges and almost negligible selling expense. At first such a plant is a local institution; but upon development, its marketing organization is extended progressively over a greater area, until ultimately national importance may be attained.

But there are also chemical engineering industries of large proportions in which proximity to the market is essential to success. An interesting example is found in the illuminating gas industry. Here the raw material —bituminous coal—can be brought to consuming centers at reasonably low cost, whereas the finished product would require an enormous capital investment in pipe lines, pumps and accessory equipment for efficient transport to market. Again, in the petroleum industry, it is usually feasible to transport the crude oil farther than the refined products, the effective domestic distribution of which is economical only from large centers of consumption, due to highly competitive conditions within the industry.

3. Source of Fuels and Power.—In the chemical engineering industries as a whole, sources of fuels and power do not rank with raw material sources and markets as a location factor. However, in some industries of this group it has equal importance, and in one branch, electrochemicals, it is dominant. Thus Niagara Falls and Shawinigan Falls have become logical centers of the electrochemical industry, producing aluminum metal, calcium carbide, carborundum, caustic soda and chlorine at the lowest possible cost. More recently, Washington State and Muscle Shoals have shown considerable promise of attracting electrochemical industry, as hydroelectric developments of considerable proportions will assure an abundance of cheap power.

Pulp and paper mills, which are among the largest industrial consumers of power, frequently are identified with hydro-electric developments, a complementary advantage being the necessity of an abundant supply of clean, fresh water. Cement, glass and clay products plants all require large quantities of fuel for process heating, and in these industries, cheap coal and proximity to the natural mineral raw materials constitutes a great advantage.

4. Source of Labor.—In general, the labor problem is important in proportion to the skill of the workers employed, and also to the total number employed. Chemical engineering industries taken as a whole employ a lesser proportion of skilled labor than do the mechanical process industries; consequently the location of a plant with respect to labor supply is relatively unimportant. It is true that skilled labor is a factor in the manufacture of paint and varnish, clay products, glass and leather, but these are among the very industries in which chemical technology has made the slowest progress. As time goes on we should expect manual skill to be of less importance in every branch of chemical engineering industry. Continuous or semi-continuous processes will more nearly take the place of intermittent processes, and the industry in certain branches is just beginning to realize the possibilities of efficient material handling equipment. Already, significant advances have been made in this direction. In the fertilizer, petroleum refining, soap and sugar refining industries, labor of all kinds has been reduced to a surprising minimum, that is, to the point where wages represent but from 5 to 10 per cent of the total cost of production.

5. Transportation Facilities.—Closely related to the factors of raw material supply and markets for finished products, is that of transportation. In many of the chemical engineering industries, such as iron and steel, lime, cement, clay products, fertilizer, heavy chemicals, petroleum refining, sugar refining and pulp and paper, freight on both the raw materials and finished

products is such a considerable item that it may be a controlling factor in market determination. Low bulk value is a characteristic of the raw materials of chemical engineering industries, and of many of the finished products as well.

Good means for transportation increases the allowable shipping distances for raw materials and finished products, thus widening the potential markets and increasing the total profits of a business. As a rule, the most favorable transportation facilities will be had near large cities that occupy a seaboard or waterway position. In such a location a choice may be had between water and rail shipping, and this is particularly advantageous should it become desirable at any time to enter the export market. Hence it is not surprising to find large centers near cities that combine the obvious advantages of both rail and water transportation. Boston, Providence, Brooklyn, Port Newark, Bayonne, Buffalo, Cleveland, Chicago, Philadelphia, Wilmington, Baltimore, Norfolk and San Francisco are all illustrations to the point.

In order to illustrate quantitatively the principles of plant location as applied to the chemical engineering industries, the feasibility of Muscle Shoals as a large fertilizer manufacturing center is discussed herewith. The data of this example were obtained from "The Problems of Muscle Shoals," a report prepared for the Muscle Shoals Inquiry by Charles H. MacDowell. The conclusions reached are illustrative only, and do not necessarily reflect the editorial stand of *Chem. & Met.* on this problem.

The Disposition of Muscle Shoals, a Problem in Plant Location

Because of the possibility of using the Muscle Shoals development for producing large quantities of fertilizer materials, a thorough investigation has been made into the costs of production and distribution of phosphoric acid in particular. Proponents of this program have claimed that large savings would accrue to the farmer by utilizing the cheap water power of Muscle Shoals for the centralized manufacture of fertilizer on an enormous scale, the product to be shipped in highly concentrated form to all parts of the United States. The following analysis would seem to indicate that Muscle Shoals is not a favorable economic location for the large-scale production of concentrated fertilizer materials. Neither does it appear to possess any particular advantages with respect to the distribution of these products:

1. Sources of Raw Material Supply.—Fertilizers contain plant food, such as "available" compounds of nitrogen, phosphorus and potassium, either alone or in suitable combination. The producer of these compounds at Muscle Shoals would have to rely upon the same sources of raw materials as do other producers.

The quantitative relation of the three materials is shown by the following estimate of United States consumption for 1923:

	Units		Per Cent
Nitrogen as NH_3,	21,353,710	=	16.1
Phosphorus as P_2O_5,	67,413,811	=	64.5
Potassium as K_2O,	21,356,102	=	19.4

From the foregoing figures it can be seen that a consideration of the production and distribution of phosphorus compounds is the controlling factor. The firmly established position of nitrogen compounds, that is, ammonium sulphate from byproduct coke plants, and sodium nitrate from natural Chilean deposits, places Muscle Shoals at an economic disadvantage as a producing center for these important fertilizer materials. Furthermore, potash must be obtained elsewhere. It is true that the Southern Appalachians contain high-grade potash feldspars, but the commercial utilization of this mineral does not appear to be practicable at present.

The problem therefore hinges upon the commercial feasibility of making phosphorus-containing fertilizer materials at Muscle Shoals. At present there are two possible processes for obtaining available phosphorus from the natural rock. The older method, in which the rock is treated with sulphuric acid, is a logical commercial development, as a large part of the acid for the process is obtained as a byproduct from the smelting of zinc and copper ores. By this method, a product is manufactured that contains from 16 to 21 per cent of available phosphoric acid, and this is about the concentration of commercial fertilizers. From start to finish, the acid process is extremely efficient chemically, and recent mechanical improvements have further lowered the cost of production.

Obviously the manufacture of phosphoric acid by the acidulation method is not to be desired at Muscle Shoals. However, it would be possible to produce a high-grade phosphoric acid by the electric furnace method, thereby taking advantage of the existing power development. Assuming conservative operating conditions, with power at $10 per horsepower-year, and with continuous manufacturing, double superphosphate could be produced at Muscle Shoals in the electric furnace for 48 cents per unit of available phosphorus pentoxide. However, with power at $20 per horsepower-year, which is the lowest expected rate at the present time, the cost would be 56 cents per unit. A plant at Muscle Shoals would purchase its phosphate rock from Tennessee, where production costs are high, and tide water competitors

Table I—Estimated Unit Costs of Materials at Muscle Shoals Versus Other Important Fertilizer Centers, Unmixed, in Pile at Plant

			Phosphoric Acid	Ammonia (*e*), Potash (*f*) (Available P_2O_5)			
Number of Primary Plants	Location of Plants	Cost of Rock per Unit P_2O_5 Content (*b*)	From Acid (*c*) Phosphate per Unit	From Double Superphosphate per Unit	From Sulphate of Ammonia per Unit	From 30 Per Cent Manure Salt per Unit	From 50-58 Per Cent Muriate per Unit
.	Muscle Shoals	$0.125-.167		$0.48(*a*)	$2.04(*d*)	$0.64	$0.66
5	Georgia	.19 Fla.	$0.45	.51	2.20	.60	.64
5	N. Carolina	.20 Fla.	.50	.56	2.30	.61	.63
5	S. Carolina	.19 Fla.	.48	.54	2.30	.58	.62
3	Alabama	.20 Fla.	.45	.51	2.07	.65	.67
1	Tennessee	.11 to .15 Tenn.	.42	.47	2.15	.63	.67
3	Virginia	.19 Fla.	.46	.52	2.16	.53	.60
4	Ohio	.25 Tenn.	.62	.70	2.13	.69	.69
1	Indiana	.24 Tenn.	.62	.70	2.13	.70	.70
2	Florida	.13 Fla.	.40	.46	2.35	.50	.58
.	Birmingham	.204 Tenn. .207 Fla.	.45	.52	2.00	.67	.68
.	Tampa	.105 Fla.	.34	.40	2.40(*g*)	.50	.58

Above costs for double super are based on 3,000 units per day of available at all points. Larger tonnage production of double super at Muscle Shoals would give inappreciably lower unit cost as a (*a*) increased tonnage calls for proportionate increase of capital invested.

(*a*) Assuming power at $10 per hp.-yr. net at furnace. If power were figured at $20 this cost would be $0.56 per unit.

(*b*) Rock cost basis 75 per cent—$5.00 for Tennessee and $3.25 for Florida, except at Muscle Shoals where low-grade run-of-mine at $2.50 for 65 per cent and $4.50 for 72 per cent, all gross ton, f. o. b. mines.

(*c*) Acid phosphate unit costs based on capacity operation.

(*d*) Assuming power at $20.00 per hp.-yr. (Cyanamid process data from George J. Roberts, "Production of Atmospheric Nitrogen." Hearing before Committee of 66th Congress). Allowance charge of $4.38 for royalty, labor and sulphuric acid included, but no overhead charge made.

(*e*) If Ammo-Phos were made at Muscle Shoals the cost of the ammonia (NH_3) would be about the same as in sulphate of ammonia. There would, of course, be a saving of sulphuric acid, but the overhead, evaporation, etc., would more than offset this.

(*f*) Potash costs basis Syndicate prices less 10 and 4 per cent.

(*g*) Price if purchased. If manufactured there, cost would approximate Muscle Shoals cost less lower cost for phosphoric acid if Ammonium Phosphate were made.

would buy rock in Florida where costs of production are comparatively low.

From the analysis given in Table I, it is apparent that the electric furnace method of making phosphoric acid from Tennessee rock at Muscle Shoals has no economic advantages, except in a few areas of distribution that are within easy reach.

Table II—Location and Size of Possible Fertilizer Markets for Muscle Shoals Production

(Figures are in tons and cover fertiliser year, ending June 30 each year.)

	1923	1924	1925*
Ohio	303,120	357,514	350,000
Indiana	195,195	189,152	225,000
Tennessee	113,620	105,417	150,000
Mississippi	215,854	316,000	500,000
Louisiana	108,711	129,288	100,000
Alabama	436,786	472,240	578,000
Kentucky	90,000	85,000	75,000
Georgia	675,869	678,959	782,334
North Carolina	1,081,811	1,189,314	1,217,467
South Carolina	678,695	881,369	864,000
Florida	398,564	365,317	328,000
Virginia	420,897	441,895	448,080

(* Estimated).

2. Market for Finished Products.—The size and location of markets that might possibly buy fertilizer materials from a large centralized plant at Muscle Shoals is shown in Table II. In theory, ample outlet is afforded, but a consideration of certain physical factors will show that the difficulties inherent in a large centralized plant are many. For example, the shipping season is quite short, being from 50 to 60 days in the South, and it would be impracticable to ship the accumulated production of an immense plant to many distant points within this time. The peak demand for cars would be all out of proportion to the carrying capacity of any railroad. Furthermore, mixed fertilizers from Muscle Shoals would for the most part pass through many favorably situated producing centers, and these smaller local assembling plants of from 30,000 to 50,000 tons output would therefore have distinct advantages in freight savings and of quick delivery to the farmer.

Table III shows the estimated cost of materials for one ton of a representative fertilizer of high concentration at the plant and delivered from Muscle Shoals into various states, versus average similar costs from primary plants into the same territories. It is obvious that for fertilizers of lower concentration, a proportionately greater advantage would accrue to the small, localized assembling plant.

Table III—Estimated Cost of Materials for One Ton of 15-5-5 at Plant and Delivered from Muscle Shoals Into Various States, Versus Average Similar Costs from Primary Plants Into Same Territories

Number of primary plants shipped from	Number of consuming points shipped to	Territory shipped into	Material cost F. O. B. plant (b)	Average freight primary plants to consuming points (c)	Average Muscle Shoals freight to same points	Primary plant material cost plus freight to consuming territory (b)	Muscle Shoals material cost plus freight to same territory double super at 48c.	Muscle Shoals material cost plus freight to same territory double super at 56c.
(M. Shoals)			$20.70(a)					
(M. Shoals)			21.90					
3	10	Georgia	20.95	$1.45	$4.86	$22.40	$25.56	$26.76
5	7	No. Car.	22.15	1.16	8.07	23.31	28.77	29.97
5	7	So. Car.	21.80	1.47	6.89	23.27	27.59	28.79
3	6	Alabama	20.45	1.39	3.59	21.84	24.29	25.49
1	5	Tennessee	20.35	2.28	3.54	22.63	24.24	25.44
3	5	Virginia	20.70	1.99	8.80	22.69	29.50	30.70
4	7	Ohio	23.40	2.30	7.47	25.70	28.17	29.37
1	6	Indiana	23.45	2.48	6.45	25.93	27.15	28.35
2	5	Florida	20.65	2.37	7.41	23.02	28.11	29.31

No cost for manufacturing allowed except that entering into the cost of making acid phosphate and double superphosphate. No allowance for bags or filler. Mixing, sacking and shipping costs would be practically the same wherever produced.

Potash figured from muriate; available phosphate (primary plants) all from acid phosphate.

(a) $20.70 with double super at 48c. and $21.90 at 56c. unit.

(b) Based on national costs in Table I.

(c) Average freights to territory are the average freights from the nearest primary plants to several of the largest fertilizer consuming points in the territory.

3. Sources of Power.—When the Wilson Dam is completed, it is expected that the total available power of the Muscle Shoals district will be 340,000 hp. of which 80,000 hp. is steam power and 260,000 hp. will be water power. It is estimated that 100,000 hp. from Wilson Dam will be primary power and the remaining 160,000 hp. will be secondary power available from 50 to 70 per cent of the year. As it has been estimated that an electric furnace installation of 550,000 hp. would be sufficient to meet present demands for acid phosphate for the entire country, it is apparent that Muscle Shoals affords ample power for a large project. Additional steam-electric plants could, of course, be built at or near existing plants. The lowest probable cost of power at Muscle Shoals is $20 per horsepower-year. Utilization of this power is, however, contingent upon congressional action, which undoubtedly would have a bearing on the proportion of power that could be used for making fertilizer chemicals.

4. Labor Conditions.—Although the problem of obtaining competent labor always is to be considered in the location of an industrial plant, it is not a problem of first rank in the manufacture of fertilizer materials. Less than 10 per cent of the cost of manufacturing fertilizers is paid as wages, and furthermore, the proportion of skilled to common labor is small. The total population of the several communities in the Muscle Shoals district is about 20,000, and the work of building an industrial community was partly completed during the War. As the climate is mild and healthful and as living costs are low, no difficulties should be experienced in obtaining and holding a satisfactory operating force.

5. Transportation.—Muscle Shoals is well situated with respect to transportation facilities. At present it is served by both the Southern Railway System and the Louisville & Nashville R.R., with lines running North, South, East and West. Furthermore, the Tennessee River affords connection with the 14,000 miles of navigable waterways in the Mississippi System.

In spite of its possible advantages for other industrial enterprises, MacDowell believes that Muscle Shoals is an illogical location for a large fertilizer plant:

"Muscle Shoals has no advantage as an assembling point for the raw materials which enter into the manufacture of mixed fertilizers. In fact, it is at a distinct disadvantage when compared with a number of existing large fertilizer-assembling districts. To manufacture fertilizers at all economically it would have to produce super-concentrated forms such as double superphosphate or ammonium phosphate on a great scale. Considering manufacturing costs alone, it has been shown that even for the production of double super-phosphate the advantage lies with such existing fertilizer centers as Nashville and Tampa, where the acid method of manufacture would be used in comparison with the electric furnace method at Muscle Shoals.

"Because of the very short shipping season and the consequent car and labor shortage and delay in delivery, experience has shown that a number of comparatively small units scattered through the consuming districts are preferable to large central plants. If a substantial block of power were used at Muscle Shoals to manufacture fertilizers, the production would be great, and shipments would be made to far-distant points. Comparison shows that for high-grade fertilizers, such as 12-4-4, 15-5-5, and even 24-8-8, small plants in the heavy-consuming districts would for the most part have the advantage over Muscle Shoals when considering raw material costs and out-freight."

Economic Side of Evaporator Scale Formation

How to calculate the cycles of maximum production and minimum cost for commercial operation

By W. L. McCabe

Department of Chemical Engineering, University of Michigan

DEPOSITION of scale on the heating surface of an evaporator is an important factor in determining capacity, and necessarily the removal of such scale is a frequent operation. As the evaporator is not on production during cleaning, and as the cleaning operation is expensive, it is often delayed as long as possible On the other hand, the longer the boiling period, the less may be the actual average production over the time of boiling. Evidently there is a definite period of boiling that will give maximum production per hour of total time of cycle. Furthermore, there is another definite boiling time that will give a minimum cost for a given production.

A means of calculating the time of boiling giving maximum production, and of the boiling time corresponding to minimum cost, is given by the relationship between the over-all coefficient of heat transfer and the total time of boiling, developed by Robinson and McCabe (*Ind. & Eng. Chem.*, 1924, vol. 16, pp. 472-3). The equation is

$$\frac{1}{H^2} = A\theta + B \qquad (1)$$

where H = over-all coefficient of heat transfer,
θ = elapsed time from start of cooling, and
A, B = constants.

The relation holds only for a single-effect evaporator operating under constant conditions of temperature difference, feed strength and the like, and when no scale separates from the heating surface. For such conditions, the equation has been verified by experimental data. The present article by Badger and Othmer presents considerable confirmatory data for equation (1), but it also points out that when crystallization takes place, the relationship may not hold throughout the boiling time.

Instead of the over-all coefficient of heat transfer, there can be used any quantity that is directly proportional to it, such as the rate of feed, the rate of evaporation, or the rate of condensate formation if the other factors are kept constant. If the rate of feed is measured, equation (1) can be written:

$$\frac{1}{F^2} = a\theta + b \qquad (2)$$

where F = lb. of feed per hr. at time θ hr. from start of boiling, and a, b = constants.

In order to utilize equation (2) quantitatively, a and b must be evaluated. Two observations of the rate of feed and the corresponding times from start of boiling will be sufficient, but it is best to make several such observations in order to obtain average values for a and b and to check the validity of the equation for the case under consideration. If the values of $\frac{1}{F^2}$ are plotted against the corresponding values of θ on ordinary co-ordinate paper, the slope of the best straight line through the points will equal a, and the distance between the intersection of the line with the $\frac{1}{F^2}$ axis and the origin will equal b. (See Fig. 1).

Equation (2) will be used to obtain an expression from which can be calculated the proper time of boiling for the following two cases:

(1) The evaporator controls the production of the entire plant, and hence the production of the apparatus is to be as great as possible.

(2) The evaporator has a definite amount of feed to handle every 24 hr. This fixed amount is less than the maximum possible capacity of the evaporator as calculated in Case 1. The cycle is to be such that the cost per day is a minimum.

Case I—Maximum Production.—Assume the following terms:

P = total lb. of feed per 24 hr.,
P_c = total lb. of feed per cycle,
X = total hr. of boiling per cycle,
c = minimum time in hr. of cleaning, refilling evaporator and starting again (assumed constant),
X_m = total hr. of boiling per cycle for maximum production,
and θ_t = total time of cycle in hr.

Then by using equation (2), solving for F and integrating, it can be shown that

$$P = \frac{24\,P_c}{X + c} = \frac{48}{a}\left[\frac{\sqrt{aX + b} - \sqrt{b}}{X + c}\right] \qquad (3)$$

For maximum production, the value of X must be chosen which gives a maximum value of P. By differentiation, equating the derivative to zero, and solving for X_m we have:

$$X_m = c + \frac{2}{a}\sqrt{abc} \qquad (4)$$

Accordingly, in order to determine the time of boiling for maximum production, it is only necessary to substitute the values of a, b and c in equation (4) and solve for X_m. As c is known and as $\theta_t = X_m + c$, the total time of a cycle follows immediately.

Case II—Minimum Cost.—Although there are many different cases in which a minimum cost calculation is desirable, only one simple and commonly-occurring example will be discussed. Assume that the evaporator has some over-capacity, as calculated in Case I, but that it is required to handle a definite amount of feed each day. The time of boiling and the total time of cycle that will give the minimum cost are required.

The total cost will include: (a) The fixed and overhead charges on the equipment, (b) steam and material costs, which are proportional to the amount of feed handled, (c) direct labor cost during the boiling period, (d) cost of cleaning.

It will be seen that for the problem under consideration (a) and (b) are independent of the time of cycle, the former because a definite equipment is postulated; the latter because a constant daily production is required. The variable cost, then, is the sum of costs

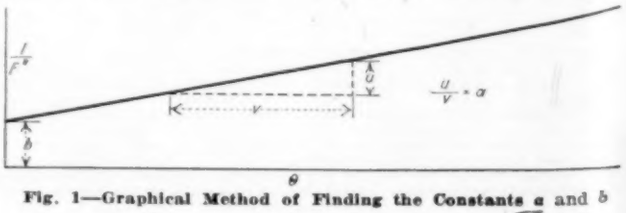


Fig. 1—Graphical Method of Finding the Constants *a* and *b*

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Summarized from a paper by W. L. Badger and D. F. Othmer, read at the Providence, R. I. Meeting of the American Institute of Chemical Engineers, June 22-27, 1925.

(c) and (d) and this sum is to be a minimum. In order to determine the time of boiling for minimum cost, the following terms are necessary in addition to those previously defined:

M = total cost of one cleaning in dollars,
S = labor cost during boiling, dollars per hr.,
X_n = time of boiling giving minimum cost, and
T = total variable costs, dollars per hr.

Then

$$T = \frac{(X)(S) + M}{\theta_t} \qquad (5)$$

also

$$P_c = \frac{(P)(\theta_t)}{24} = \frac{2}{a}\left[\sqrt{aX + b} - \sqrt{b}\right] \qquad (6)$$

Eliminating θ_t from equation (5) and (6):

$$T = \frac{aP}{48}\left[\frac{(S)(X) + M}{\sqrt{aX + b} - \sqrt{b}}\right] \qquad (7)$$

To determine the value of X for minimum cost, we differentiate T with respect to X, set the derivative equal to zero and solve for X_n. The result is:

$$X_n = \frac{M}{S} + \frac{2}{a}\sqrt{abSM} \qquad (8)$$

Therefore in order to determine the most economical boiling time per cycle, substitute the values of the constants in equation (8) and solve for X_n.

It will be noted that X_n is independent of the required daily production, P. Accordingly it is not certain from the value of X_n that if X_n were used as the boiling time, the required production would be realized and yet have time enough for cleaning. If equation (6) be solved for θ_t, there results for the particular value of $X = X_n$:

$$\theta_t = \frac{48}{aP}\left[\sqrt{aX_n + b} - \sqrt{b}\right] \qquad (9)$$

If θ_t, as computed by equation (9) be equal to or greater than $X_n + c$, then X_n can be used as the boiling time, and the required production can be attained at a minimum cost.

If equation (6) be solved for X, there results:

$$X = \frac{P\theta_t}{2{,}304}\left[aP\theta_t + 96\sqrt{b}\right] \qquad (10)$$

This equation is useful for computing the boiling time when the total time of cycle and fixed daily production are known.

In practice it will not be convenient always to operate according to the optimum values of the boiling times because of other plant conditions. For example, perhaps it is desired that a cycle consist of an integral number of days, or perhaps a cycle must synchronize with some other periodic cycle of plant operation. Fortunately, the curves of X_m vs. production and cost vs. X_n are very flat near the optimum points, and therefore wide latitude can be allowed in the choice of X without materially decreasing production or increasing costs. As much of the curve as is desired can be quickly found by assigning values to X and calculating P or S from formulas (3) or (7).

Illustrative Problem—A single-effect vertical-tube evaporator handling a solution that deposits a calcium sulphate scale contains 1,600 sq.ft. of heating surface. The body of the evaporator is large enough for 4 men to clean it at one time. The total number of man-hours necessary to clean the effect is 24, and 2 hr. is required to stop the machine, empty it, and start it up after cleaning. Accordingly, the minimum time for stopping, cleaning and starting is 8 hr. By metering the feed over a considerable stretch of boiling time, it is found that the relation between rate of feed and time is given by the equation:

$$\frac{1}{F^2} = (35.8)(10^{-12})\,\theta + (17.9)(10^{-10}) \qquad (11)$$

Labor costs during boiling are \$0.90 per hr. and cleaning costs are \$0.75 per man-hr. of actual cleaning. It is necessary that the length of one cycle be an integral number of days.

(a) What cycle will give maximum production?

(b) If 380,000 lb. of feed are to be handled every 24 hr. of total time, what cycle will give minimum cost?

Solution (a)—Use equation (4). The values of the constants are:

$a = (35.8)\ (10^{-12})$,
$b = (17.9)\ (10^{-10})$, and
$c = 8$.

Equation (4) gives $X_m = 48$ hr.

The total length of one cycle is $48 + 8 = 56$ hr. This is not an integral number of days. Accordingly a part of the production vs. time of boiling curve is drawn. Points on the curve are found by assigning values of X, substituting in equation (9) and calculating the corresponding values of P. The curve is shown in Fig. 2. It can be seen that the extreme flatness of the curve allows the choice of a cycle complete in either 2 or 3 integral days without much loss in production. If the 72 hr. cycle is chosen, the production (read from the curve) will be 403,000 lb. per day, whereas the maximum is 406,000 lb. per day.

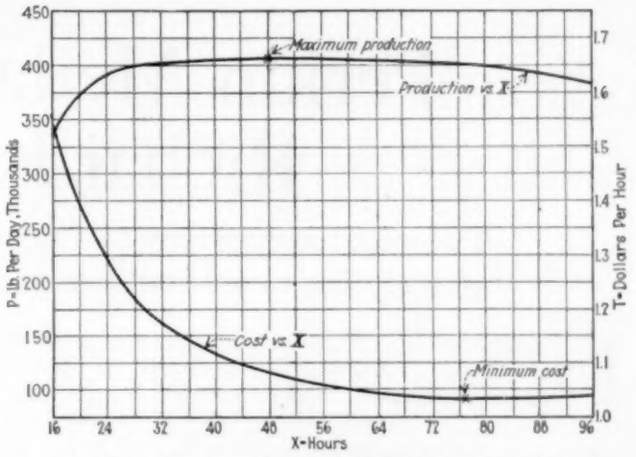


Fig. 2—Maximum Production and Minimum Cost Curves

Solution (b)—Use the minimum cost formula, equation (8), by substituting the following numbers for the letters:

$M = (24)\ (0.75) = 18$ $\qquad$ $a = (35.8)\ (10^{-12})$
$s = 0.90$ $\qquad$ $b = (17.9)\ (10^{-10})$

The result of the calculation shows

$X_n = 77$ hr.

If X_n is used as the boiling time per cycle, the total time can be calculated from equation (9). The value to be substituted for P is 380,000 and the other quantities are as above. The result is $\theta_t = 89$ hr., which is not an integral number of days. The plotting of the time-cost curve by calculating co-ordinates with equation (7) shows that very little difference in cost results through a wide range of boiling times. Accordingly, a total time of cycle of 72 hr. or of 96 hr. will be nearly as economical as the true optimum and meets the restriction of filling an integral number of days.

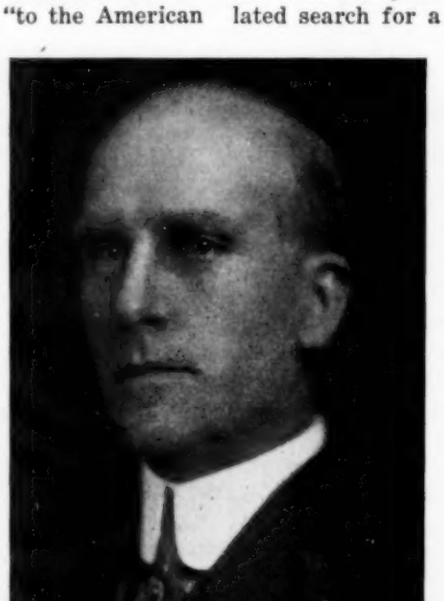
It has been shown under part (a) that a total cycle length of 72 hr. will take the nearly maximum feed of 403,000 lb. per day. If the same cycle be decided upon as a result of the calculations in part (b), it is evident that more than the 8 hr. shutdown time will be available under the conditions of part (b), because a definite daily feed of only 380,000 is postulated. Hence, the total length of cycle of 72 hr. will give very close to minimum cost (under the conditions of part (b)), and yet can give nearly maximum production if required to do so.

The actual boiling time corresponding to the 72 hr. cycle under the conditions specified in part (b) can be calculated by equation (10). The value of X so computed is 60 hr., and the best all-around cycle for problem (b) would consist of 60 hr. for boiling and 12 hr. for shutdown.

Perkin Medal Awarded to Richard B. Moore

Twentieth impression of famous medal presented in recognition of recipient's contributions to production of radium and helium

IN PRESENTING the twentieth impression of the Perkin Medal to Richard Bishop Moore on Jan. 15, 1926, Dr. William H. Nichols recalled the fact that it had been his pleasure also to present the first impression of the medal to Sir William H. Perkin in 1906 on the occasion of the latter's visit to this country. The medal is awarded annually by the American Section of the Society of Chemical Industry "to the American chemist who has most distinguished himself by his services to applied chemistry." Dr. Moore was selected on account of his pioneer work in the production of radium and helium in the United States.



Richard Bishop Moore

Following introductory remarks by Dr. H. S. Miner, chairman of the American Section, Prof. Herman Schlundt of the University of Missouri, and Dr. S. C. Lind of the Fixed Nitrogen Research Laboratory, gave brief reviews of Dr. Moore's life and work. The medalist had previously been associated with these men at the University of Missouri and in the Bureau of Mines respectively.

Responding to the presentation, Dr. Moore refrained from reading a formal paper which he had prepared on the technology of the production of radium, mesothorium and helium, and spoke informally on his personal experiences in developing these industries in this country. He recounted publicly for the first time some of the difficulties encountered, the obstacles and inertia that had to be overcome before success crowned the work of himself and associates in governmental departments.

Following a survey by the Bureau of Mines of the carnotite deposits of Colorado and Utah, Dr. Moore wrote in 1913 that "the United States possesses unique deposits in these carnotite ores. They constitute at present the largest supply of radium minerals in the world." At that time these ores were being shipped abroad for radium recovery, and it was evident that a great natural resource was being lost to the country. A campaign was begun for conservation and domestic treatment which resulted in a co-operative agreement between the Bureau of Mines and the National Radium Institute for the production of 7 grams of radium element, the funds to be furnished by the Institute and the technical knowledge and skill by the Bureau under Dr. Moore's direction. The result of that effort was the production of 8.5 grams of radium element and 60,000 lb. of 95 per cent uranium oxide. The success of this effort gave an impetus to American production of radium that was not abated until the discovery of unusually rich radium ores in the Belgian Congo in 1922 made domestic production unprofitable from comparatively lean ores.

A lapse of three or four years occurred between the medalist's production of radium and his active interest in the recovery of helium. The World War had stimulated search for a non-flammable buoyant gas for balloons and dirigibles, and the hope of obtaining helium for that purpose was communicated by letter to Dr. Moore by Sir William Ramsay in February, 1915. Apparently the British Admiralty, which had enlisted the aid of Sir William Ramsay, did not know of the work of Cady and McFarland in 1907 on the natural gas of Kansas, which was shown to contain helium in perceptible quantities. As the United States was not at war in 1915, nothing was done until April 1917 when, at a meeting of the American Chemical Society in Kansas City, Dr. Moore discussed a paper on the presence of rare gases in the natural gas supplies of Kansas. He announced the interest of the British Admiralty in the matter and urged that production in this country was feasible and should be undertaken. In the following June the matter was seriously discussed in the Bureau of Mines at Washington by Dr. Moore and G. A. Burrell who had learned from another source of the British interest in helium. The outcome was an interview by Moore and Burrell with Colonel Chandler of the Balloon Division of the Army, which marked the beginning of definite efforts to produce helium in the United States.

From that time on events moved rapidly, culminating in the erection of three experimental plants by the Linde Air Products Co., the Air Reduction Co. and the Jeffries-Norton Co., the last under the direct supervision of the Bureau of Mines. All three plants were located in Texas, two at Forth Worth and one at Petrolia. The Jeffries-Norton plant was finally abandoned, but the other two produced helium; and at the signing of the Armistice the first consignment of 147,000 cu.ft. of 93 per cent helium was on the dock for shipment to Europe.

The story of subsequent developments is one of arousing public interest in helium for air ships, sustaining Congressional support, conserving helium supplies on private and public lands, and steadily improving the technology and decreasing the cost of production.

Ultra-Purification of Gas Mixtures

Methods developed for synthetic ammonia process applicable to other gas reactions in which catalytic poisons are a factor

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IN HETEROGENEOUS catalytic reactions the close chemical control of the composition of both the catalytic material and the reacting gases is of the utmost importance in order to insure the absence of compounds which inhibit or prevent entirely the progress of the desired reaction. This has been particularly true in the case of ammonia synthesis. Indeed, it can be said that the recent rapid development of this art dates from that time when it was realized that the catalytic formation of ammonia is susceptible to inhibition by the presence of certain compounds in concentrations so small as to be regarded ordinarily as insignificant. The Badische Anilin und Soda Fabrik as a result of their early work on the technical adaptation of ammonia synthesis recognized the importance of gas purity, and since that time nearly all patents in this field have specified the use of gas mixtures substantially free from poisons. The degree to which gas purification must be carried depends on the catalyst material to be used and on the conditions of operation. It is necessary to maintain a particularly high degree of gas purity in order to get the maximum in activity and life from low-temperature catalysts.

Gaseous contact poisons can be classified as reversible or temporary poisons and non-reversible or permanent poisons. Reversible poisons are those that inhibit the reaction only while present in the gas and from the effects of which the catalyst is able to recover when treated with pure gas. Typical poisons of this type for iron ammonia catalysts include oxygen, carbon monoxide and other oxygen-containing compounds that are catalytically converted to water in the presence of hydrogen. The non-reversible poisons are those that inhibit catalysis permanently, usually by reacting with the catalyst to form a compound that is not readily removed by continued treatment with pure gas. Sulphur compounds and phosphorus may be classed as non-reversible poisons for reduced iron catalysts. The distinction just made between the common reversible and non-reversible poisons for iron ammonia catalysts is not a strict one, since poisons like sulphur may become essentially reversible at high temperatures if present in sufficiently small quantities. A more extreme example of irreversible poisoning is that of oxygen for reduced metal catalysts like cerium,[1] the oxide of which is not reducible by hydrogen.

Quantitative data on the poisoning action of compounds of certain non-metallic elements such as sulphur and phosphorus are lacking, but experience at this Laboratory has indicated that concentrations of a few parts per million are effective poisons at temperatures around 500 deg. C. The effect of passing purified gas through rubber tubing may be cited as an illustration of the sensitivity of catalysts to poisoning by what was in all probability a volatile sulphur compound. A typical iron ammonia catalyst treated directly with a purified hydrogen-nitrogen mixture at one atmosphere and 400 deg. C. gave 0.39 per cent NH_3 in the effluent gas at 5,000 space velocity. When the same gas was passed through 82 cm. of cold-cured gum tubing before reaching the catalyst, only 0.02 per cent NH_3 was detected in the effluent gas. Even with rubber tubing that had been treated with 10 per cent NaOH solution and dried thoroughly, the ammonia formed under the above conditions was only 0.15 per cent.

Some data on the reversible poisoning effect of carbon monoxide and water vapor were presented in an earlier paper[2] from this Laboratory with the conclusion that equal volume concentrations of these gases produce equal effects, since the carbon monoxide is converted to water by the catalyst. The results of tests with oxygen, methyl alcohol and ethyl alcohol indicate that this proportionality between the poisoning effect and the oxygen content holds for other compounds that are capable of being transformed to water under the conditions of ammonia synthesis. There are presented in Table I some experimental results showing the inhibition of catalytic activity produced by comparatively small concentrations of two typical reversible poisons, carbon monoxide and water vapor. The volume percent of ammonia in the gas leaving the catalyst is given in the table as a measure of the catalytic activity. The tests were made at 100 atmospheres and 5,000 space velocity on catalysts made from fused iron oxide[3] containing potassium and aluminum oxides as promoters. The gas referred to as pure gas was prepared by burning electrolytic hydrogen in air and was subsequently purified after compression by passage over reduced copper and nickel catalysts, soda-lime, alumina gel and fused potassium hydroxide.

Table I—Effect of Typical Reversible Poisons on Catalytic Activity

Temp., Deg. C.	Per Cent NH_3 with Pure Gas	Per Cent NH_3 with Gas Containing— 0.04 Per Cent CO	0.08 Per Cent H_2O
450	12.3	6.0	2.1
475	11.8	7.8	4.0
500	10.4	8.6	5.8
525	9.2	7.9	6.6

The decrease in activity is marked particularly at the lower temperatures.

The temporary nature of the poisoning action of small concentrations of reversible poisons on an active catalyst is illustrated by the results in Table II. This catalyst

Table II—Summary of Treatment During Test

Type of Operation	Time, Hours	Av. Activity Expressed as Per Cent NH_3 in Effluent Gas Obtained at 450 Deg. and 5,000 S. V.
Pure gas	1,733	14.2
Compressed gas saturated with H_2O at 0 deg. C.	144	11.0
Compressed gas saturated with H_2O at 25 deg. C.	808	7.8
Gas dried by soda lime only	112	13.1
Final activity on pure gas after treatment	...	14.2

prepared from fused iron oxide contained 2.33 per cent Al_2O_3 and 0.60 per cent K_2O and was in continuous use for almost 4 months at 100 atm., 5,000 space velocity

and at temperatures between 450 deg.-500 deg. C. During this time it was submitted to poisoned and pure gas intermittently.

The foregoing results illustrate the effects produced by relatively small concentrations of certain poisons on low temperature catalysts and emphasize the desirability of submitting the gas to an ultra-purification treatment for their removal. The common gaseous impurities that exert a particularly deleterious effect on iron ammonia catalysts are the compounds containing sulphur, phosphorus, halogens and oxygen.

The methods that have been recommended for the removal of these substances fall into one of the following classes: (1) absorption methods, comprising those in which the harmful impurities are retained by the purifying agent, with or without the evolution of a harmless substance; (2) catalytic conversion methods, comprising those in which the harmful impurity is transformed into a harmless one or into another deleterious impurity that can be more easily removed than the original poison. Many of the absorption methods are carried out under pressure and provision must always be made for renewal of the spent absorbent. It is often necessary to combine the catalytic conversion methods with one or more absorption steps. The references given below are examples of the methods and reagents as revealed by a survey of the literature and it is not suggested that all are of proven applicability. (For a brief discussion of many of these methods, see *H. S. Taylor* "Industrial Hydrogen," Chemical Catalog Company, New York.)

Carbon Monoxide Difficult to Remove

Carbon Monoxide—Carbon monoxide is one of the most difficult of the common poisons to remove completely. Several reagents have been suggested as absorbents. The patents have specified acid cuprous chloride solution[4] and ammoniacal cuprous chloride solution.[5] Later the use of ammoniacal cuprous solutions free from halogens[6,7] has been proposed in order to eliminate the corrosive effects of halogen-containing solutions on the iron apparatus. The ammonia introduced by the use of these ammoniacal solutions gives rise to no difficulties but the traces of water vapor in the gas mixture must be removed. (Where reference is made to the removal of traces of water, it is assumed that the ammonia synthesis process is to be operated with removal of the ammonia by liquefaction. In case water absorption of the synthesized ammonia is employed, no attempt is made in practice to reduce the water content of the gas below that corresponding to saturation at the temperature of absorption.)

Other liquid absorbents that have been patented for carbon monoxide removal are hot caustic solutions,[8] fused caustic,[9] organic liquids,[10] particularly ethyl ether,[11] molten sodium,[12] liquid ammonia,[13] a solution of an alkali metal in liquid ammonia,[14] and liquid nitrogen.[15]

Of the above absorption methods, only one, that of scrubbing the compressed gas with ammoniacal solution of cuprous carbonate or formate, is now being used in the purification of gases for commercial ammonia synthesis. The use of hot caustic solutions was given some consideration in the early development of the Bosch water-gas process but it has now been superseded by the ammoniacal cuprous solutions.

The solid absorbents that have been proposed are heated calcium carbide,[16] lime or soda-lime,[17,18] caustic,[19] alkali metal amides,[20] and metallic tungsten and molybdenum.[21] These solid absorbents appear to be of doubtful applicability because of the high temperatures that would be required to make them reactive with carbon monoxide.

The conversion methods for carbon monoxide removal comprise either (1) catalytic conversion by steam to hydrogen and carbon dioxide; (2) catalytic conversion by hydrogen to methane and water; (3) preferential catalytic oxidation to carbon dioxide. The first of these, used extensively in the production of hydrogen from the carbon monoxide of water-gas, is not suited for the complete removal of carbon monoxide because of unfavorable equilibrium limitations that prevail at present operating temperatures, and it must therefore be followed by additional purification steps for the removal of the final 1 per cent or more of carbon monoxide. The catalytic conversion of carbon monoxide by hydrogen into methane and water may be employed, using nickel and cobalt catalysts[22,23,24] at 250 deg.-300 deg. C., or certain iron ammonia catalysts[25] at somewhat higher temperatures. The methane formed in this reaction is not harmful to ammonia catalysts, but its presence in large quantities is undesirable since it accumulates in the system and acts as an inert diluent for the reacting gases. The water that is formed during methanation must be removed before ammonia synthesis. The methanation of carbon monoxide is one of the purification steps in the Claude process.

The preferential catalytic combustion of carbon monoxide in the presence of hydrogen can be accomplished under closely controlled conditions in the presence of suitable metallic oxide catalysts.[26,27] This process presents attractive possibilities but has not as yet attained much industrial importance because of the difficulties involved in maintaining the necessary close control. Any excess of oxygen admitted for combustion must subsequently be removed as well as the carbon dioxide formed.

A patent[28] has recently been granted to Casale for a method of carbon monoxide removal within the circulatory system by reaction with the hot ammoniacal gases beyond the catalyst converter. The compounds formed are removed by liquid ammonia.

Carbon Dioxide Is Readily Absorbed

Carbon Dioxide—The removal of carbon dioxide is readily effected by absorption in various reagents. The solid absorbents include calcium carbide,[16] lime,[29] soda-lime,[30] caustic soda.[31] Liquid absorbents are water, caustic solutions,[31] lime water,[29] suspension of magnesium hydroxide,[32] aqueous ammonia solutions,[34] alkali metal carbonate solutions,[35] liquid ammonia,[13] and a solution of an alkali metal in liquid ammonia.[14] As in the case of carbon monoxide the catalytic conversion of carbon dioxide by hydrogen into methane and water can be effected by suitable contact agents.[22,24] Present practice for carbon dioxide removal as typified by the Bosch water-gas process, comprises scrubbing the compressed gas first with water and then with alkaline solutions.

Oxygen—The direct removal of the last free oxygen from hydrogen-nitrogen mixtures is possible by the use of such reagents as sodium,[12] ammoniacal cuprous solutions,[6,7] and alkali metals dissolved in liquid ammonia.[14] Scrubbing of the compressed gases with ammoniacal cuprous solutions as used in the Bosch water-gas process removes oxygen as well as carbon monoxide. It is often convenient, however, to convert the free oxygen

to water by passage of the gas over a catalyst and to remove the water formed. Platinized asbestos,[29] metallic copper,[30] and other metals are frequently used as contact substances.

Sulphur Yields to Absorption Processes

Sulphur—Sulphur and its compounds are most effectively removed by absorption methods or by a combination of conversion and absorption processes. The absorbents that have been proposed include heated copper,[31] iodine dissolved in potassium iodide solution,[32] copper sulphate solution,[33] hot caustic solution,[34] aqueous ammonia solution,[41] and iron oxide mixed with wood shavings as used in the gas industry. A combination method has been proposed[42] which comprises scrubbing the gas with sodium carbonate solution before passing through the iron box purifier. Patents have been taken out for the conversion of carbon disulphide to hydrogen sulphide before absorption. These involve either the catalytic reaction with steam over oxide catalysts,[43] or with hydrogen over reduced metal catalysts.[44] Carbon oxy-sulphide, COS, often occurs with the hydrogen made from water-gas and it apparently resists removal by the ordinary water-gas purification system. A patent[45] has been issued covering its removal by absorption on charcoal saturated with aqueous ammonia. It has also been observed[46] that it is quite readily soluble in dilute and concentrated solutions of alkali, but not in solutions of intermediate concentration. The cooling of the gases to about —190 deg. C. has been claimed as a method[47] for the final removal of sulphur compounds including mercaptan and thiophene. Experience with the Bosch water-gas process has shown that the sulphur compounds, with the possible exception of COS, are effectively removed during the regular purification treatment. The oxide catalyst for the carbon monoxide conversion reaction converts most of the CS_2 to H_2S which is then removed in the scrubbing steps that follow.

Halogens—The free halogens may be removed by direct absorption in molten sodium[13] or caustic solutions, or they can be converted catalytically by hydrogen into the halogen acids which are then absorbed in suitable solutions.[50]

In order to protect the ammonia catalyst from small concentrations of any of the gaseous poisons listed above it has been proposed[51] to pass the contaminated gas first over a material identical with the ammonia catalyst and maintained at about the same temperature. This "sacrifice" material is designed to retain the permanent poisons and to function as a conversion catalyst for certain of the reversible poisons. It will gradually become poisoned to such an extent as to necessitate removal.

Phosphorus Removal May Assume Great Importance

Phosphorus—The removal of phosphine, PH_3, may be accomplished by decomposition over heated copper under such conditions that the phosphorus is retained in combination with the copper. Acid solutions of copper salts such as the hydrochloric acid solution of cuprous chloride are also capable of removing phosphine by formation of the copper phosphide. The subsequent removal of the acid vapors would be necessary. The use of oxidizing agents such as chromic acid may be applicable. Bleaching powder in lump form has been proposed as an oxidizing agent,[48] but here too it would be necessary to remove the chlorine introduced. Phosphine removal by solution in petroleum at low temperatures has also been suggested.[49]

The removal of phosphine from hydrogen has not been an industrial problem, but it now promises to be of greater importance in connection with the recent development of a process for producing hydrogen and phosphoric acid by the interaction of steam and phosphorus. The use of this hydrogen for ammonia synthesis requires that it be free from phosphine and other volatile phosphorus compounds and the problem of their removal will no doubt receive more attention than it has in the past.

Water—The problem of water removal from gas mixtures has been reserved for the last because of its great importance. It is evident from the preceding paragraphs that absorption methods of ultra-purification are available for removing any of the catalyst poisons likely to be encountered, but that most of these methods will be expensive and complicated because of the special materials required and the necessity for continued renewal of the absorbing agent. It is also evident that the catalytic conversion methods applied after compression of the gas mixture, although cheap and simple, are all dependent for their ultimate effectiveness on the ease and completeness with which traces of water vapor can be removed. If there is available some effective and simple means of removing completely from the gas mixture traces of water, the common ultra-purification problem becomes an extremely simple one of catalytically converting oxides of carbon to methane and water, and oxygen to water by means of a suitable contact agent or agents. (Since the catalysts for effecting these conversion processes are themselves sensitive to poisons like sulphur it is necessary that such substances be removed first by direct absorption if the conversion catalyst is to function at maximum activity for a long period of time).

Solid Absorbents for Water Impracticable

Many absorbents for water are known—among them are sodium,[13] quick-lime,[52] calcium chloride,[51] phosphorus pentoxide,[51] alkali-metal amides,[29] liquid ammonia,[13,53,54,55] alkali metals dissolved in liquid ammonia,[14] alkaline earth cyanides or cyanamides,[56] alkaline-earth carbides,[57] caustic potash,[58] and porous gels such as alumina[54] and silica gels.[55] Many of the proposed reagents for water removal are of doubtful value and the use of the common drying agents, phosphorus pentoxide and sulphuric acid is to be avoided, since they are known to introduce volatile catalyst poisons. The necessity for rather frequent renewal of the dehydrating agent makes the use of many satisfactory solid absorbents impracticable, particularly for the drying of compressed gas. The utilization of liquid ammonia as a drying agent is particularly well adapted to the final drying of the compressed and purified gas mixtures for ammonia synthesis, since it is produced in the process itself and is readily renewable. The ammonia which has been used for drying is still a valuable and marketable product.

In the process employing liquid ammonia[55] described above, the ammonia required for drying is produced by a rugged iron ammonia catalyst operated under conditions which permit its functioning simultaneously as a conversion catalyst for oxygen compounds and as an ammonia synthesizer. The water produced is removed by condensing part of the ammonia thus synthesized.

The applicabilitiy of such an arrangement will obviously depend upon the properties of the rugged purification catalyst and upon the concentration of poison present in the gas. As described in the above reference[35] it was designed primarily for the final removal of reversible poisons present in concentrations not exceeding a tenth of one per cent. An alternative arrangement and one that appears to be more suitable in the presence of higher poison concentrations would be to operate the purification catalyst only as a poison converter and to introduce from another source the liquid ammonia required for drying. This permits the use of catalysts such as copper and nickel which are somewhat more active than iron as conversion catalysts but which have no appreciable activity as ammonia catalysts.

The catalytic conversion processes for the final removal of small concentrations of gaseous catalyst poisons as described above for the case of ammonia synthesis are applicable also to the purification of hydrogen for other catalytic reactions in which the removal of the same poisons is desired.

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Coal Strike and Steel Market a Factor in 1925 Coke Production

Because the coke industry is so intimately interlocked with the metallurgical industry the demand for coke and the production of byproducts depends largely upon the demand for steel. During 1925 there was a slight falling off in byproduct coke and coke byproduct output because of the conservatism in steel purchasing. It was first noted during the spring. This decline reached a maximum in July and the output has since then been climbing.

The increase in coke demand which has stimulated both beehive and byproduct production during the fall and winter months has resulted not only from a renewed activity in metals, but also by the anthracite coal strike. The lack of anthracite for household fuel, for water gas making, and for other purposes has stimulated the demands for coke and appears to be creating a permanent and large market for this product. It appears likely that the result will be still further increase in byproduct oven capacity and still greater stability in the production of both coke and all its byproducts.

Association of the byproduct coke plants with the iron and steel industry continues as in preceding years. During the past five years there has been little variation in the percentage of the total monthly output of byproduct coke that comes from such plants associated with the metallurgical industry. Usually from 80 to 83 per cent of the total output is from such furnace plants and from 18 to 20 per cent from "merchants" coke plants. During 1925, however, the percentage from merchant plants was slightly lower, being from 15 to 18 per cent, the balance coming from metallurgical properties.

Synthetic Tanning Materials

Further researches in connection with the evaluation of synthetic tanning materials have been conducted at the Bureau of Standards in order to determine their hydrolytic action on hide substance. The results varied greatly with individual syntans, some showing a loss of hide substance as low as one-twentieth per cent in a solution having normal acid concentration, as compared with others which showed practically complete destruction of the hide sample in half normal solutions. Six different syntans were examined in this manner, but the information obtained does not allow any definite classification as to those which will have either low or high hydrolytic action.

Progress in Glass Technology

Review of recent investigations into properties and manufacture made at the Bureau of Standards

THE major portion of the work being done at the Bureau of Standards in its investigation of glass has to do with studies in the production of optical glass. This of course is due to the fact that the military branches of the Government, with which the Bureau co-operates very closely, are the largest consumers of optical glass—not to be confused with eyeglass lenses—in this country. The intense activity of the bureau in the production of optical glass, maintained during the war, has of course subsided, but considerable work is still being done in the study of such production as will lead to increased yield, better quality, and the development of methods of testing.

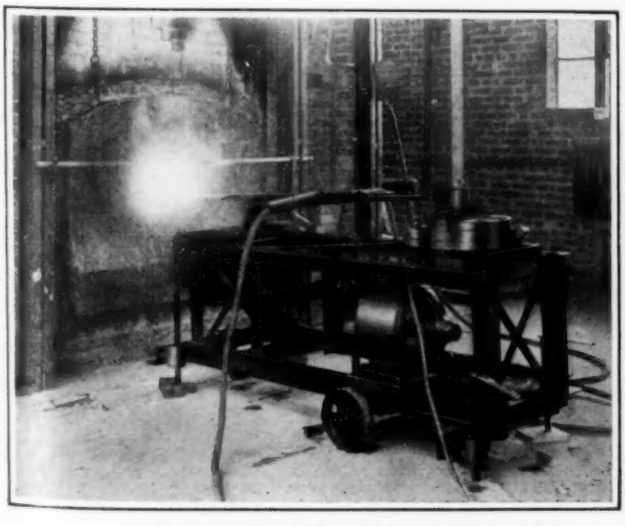
Forty-five melts, of 4 different types of glass, have been made during recent times. The types represented boro-silicate, light crown, light barium crown, and medium flint glasses. This was largely molded into various sizes of optical blanks, lenses, and prisms. A total of approximately 7,000 blanks was so molded. These ranged in size from 15 to 112 mm. diameter for the lenses, and from 22 to 83 mm. square faces for the prisms. The annealing of these was carried out in a furnace which was designed at this bureau, consisting of a copper box 36 in. in diameter, 7 in. deep and 1 in. thick. This is heated electrically, the heating coils being placed on the top and bottom, and the whole is entirely insulated with 8 in. of Sil-O-Cel. The temperature, which is measured by thermocouples, can be kept practically constant and uniform throughout for 48 hr. (the time required for annealing 3 in. penta prisms), and the cooling rate (initially about 1 deg. per hour) is easily controlled.

Mechanical Strength of Sheet Glass—This investigation was undertaken to obtain data on the relative strength of glazing glasses. Approximately 5,000 samples of glazing glass (18 in. by 2 in.) of various types were tested for strength by transverse loading and impact. Modulus of rupture, modulus of elasticity, impact modulus of rupture, and stress strain curves were also obtained. The modulus of rupture varied from 5,000 to 13,000 lb. per sq.in., and the Young's modulus varied from 550,000 to 16,670,000 lb. per sq.in., depending on the type of glass.

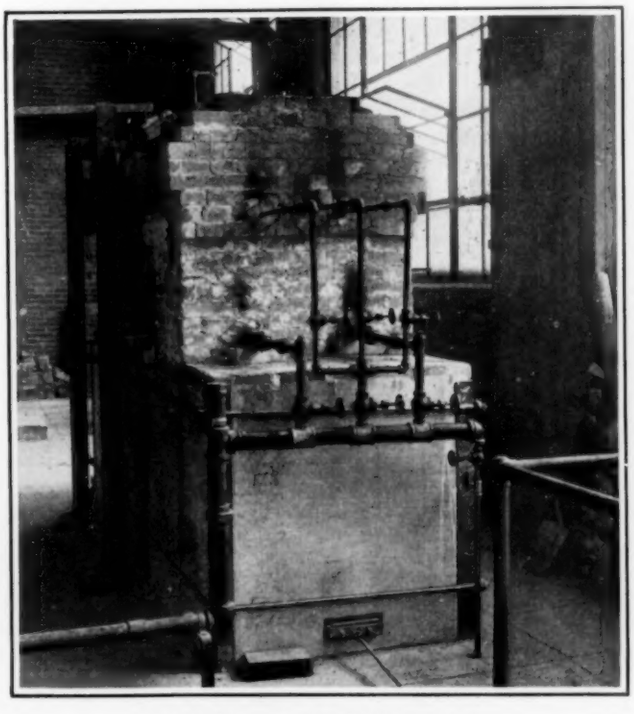
Further tests were made on pieces 12 in. by 12 in. and 43 in. by 46 in., and results indicate that the strength of the 12-in. by 12-in. sheets mounted in frames and loaded at the center is practically the same as that computed from strength obtained by transverse loading of strips 18 in. by 2 in. tested as a beam supported at two ends. Similar pieces tested with hydraulic pressure indicate that the strength of thin glass is relatively greater than that of thicker glass.

Classification and Identification of Stones in Glass—Glass often contains segregations of undissolved or crystallized material known as "stones" which not only affect the transparency and appearance of the glass, but are the cause of considerable breakage, both of which are important considerations to the manufacturer.

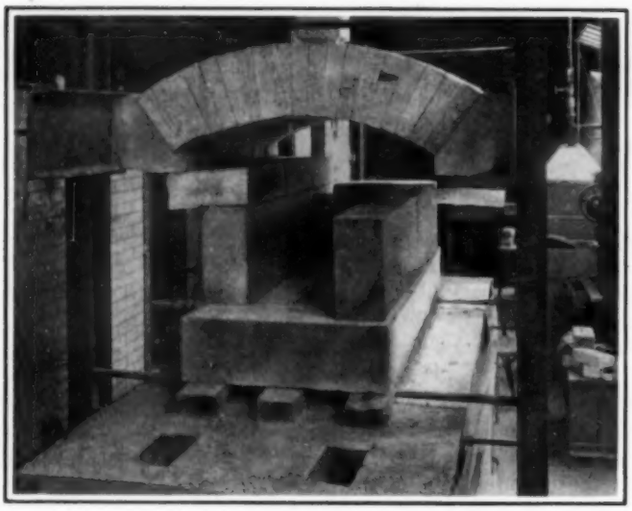
A large number of specimens of commercial glasses containing stones were examined with the petrographic microscope to determine their nature, composition, and source. In addition to some amorphous material, the stones most frequently occurring in the soda-lime glasses contain crystals of quartz, tridymite, cristobalite, wollastonite, diopside, mullite, corundum, nephelite, and a sodium-calcium silicate of undetermined composition. These may result from at least three causes: (a) devitrification, (b) incomplete solution of batch mate-



Stirring Molten Glass
To prevent the formation of striae, optical glass must be stirred during making: here is shown a mechanical stirring device.



Tank Furnace for Melting Glass
This view shows the arrangement for gas firing.



Building a Tank Furnace
The furnace is built in such a way that the tank blocks can be replaced without disturbing the crown.

rials, and (c) inclusions of refractory materials from the walls or crown of the furnace. The work has shown that the stones resulting from these three conditions are different in composition, physical, and optical properties, and that their identification serves to indicate their source and suggest means of prevention.

A detailed report, giving the method of preparing samples for examination with the polarizing microscope, methods of examination, the principal optical constants and distinguishing characteristics of the ordinary "stones," was published in the *Journal of the American Ceramic Society*, vol. 7, No. 1 under the title, "The Microscopic Identification of Stones in Glass."

Measurement of the Viscosity of Glass—This investigation was undertaken to furnish information on the temperature-viscosity relations, or the working qualities of glasses of different compositions. Information of this nature should assist in developing glasses that will "plain" more readily and is especially desirable for manufacturers using automatic glass-working machines, since their speed is largely controlled by the working quality and temperature of the glass.

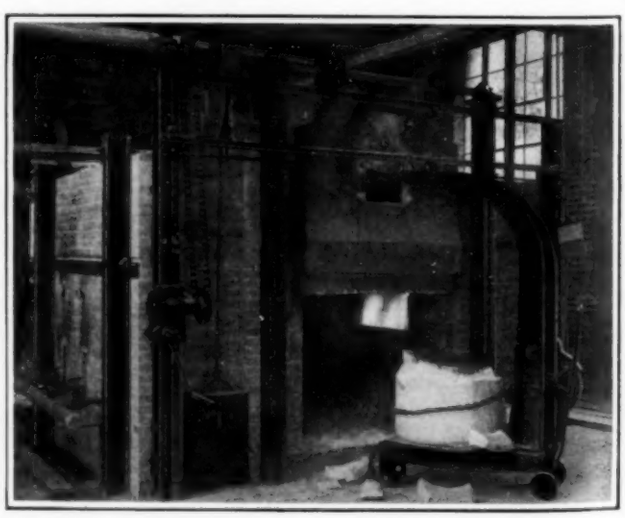
The initial work on this subject indicated that the viscosity of glass could be determined by measuring the amount of force required to turn a rod at definite speed when immersed in molten glass. Measurements made on ten glasses of the soda-lime series showed that (a) the replacement of lime by alumina, which increases the resistance of glass to weathering and the solvent action of water, increases the viscosity; (b) an increase in the silica-lime ratio decreases the viscosity; and (c) the substitution of magnesia for lime increases the viscosity.

Since the viscosity of a glass may change from 25,000 to 88,000 poises with a change in temperature of 40 deg. C. in its working range, it became evident that the greatest possible accuracy in temperature control, and methods of measuring the force required for a given speed of rotation are very essential. These were only attained after numerous trials and changes in the number and arrangement of heating coils and in the insulation of the furnace, and by the use of an automatic timing device. The modified apparatus now gives uniform temperatures (±5 deg. C.) throughout the glass under examination, and the speed of revolution can be measured within 1 per cent. Determinations made under these conditions have given more satisfactory and consistent results than those previously obtained.

Correlation of Analyses and Physical Properties—Chemical analyses of 25 glasses varying from the simple soda-lime type to the complex borosilicate glasses were made. The use of lime in glasses of the lead series has been discontinued because it was found that the presence of lime, which is added to improve the working quality of the glass, can be omitted and at the same time a more satisfactory relation between index of refraction and dispersion can be secured. In lead glasses in which N_d = approximately 1.620, the dispersion is reduced from 37.5 to 36.6 by replacing the 2 per cent of lime by silica. In a similar way, reductions in the zinc oxide content of borosilicate glasses from 2.5 per cent to less than 0.5 per cent reduce the dispersion of glasses of similar index of refraction, giving a more satisfactory glass for optical purposes. The accurate determination of boric anhydride in glass is exceedingly difficult because the generally accepted methods for its determination involve a "blank" correction which is not constant. A study of the other methods leads to the conclusion that the method of Sargent which gives results about 1 per cent low is more satisfactory than any so far tried because the "blank" for this method is practically negligible.

Specifications for Sheet Glass—Specifications for sheet glass for glazing purposes were prepared by the Bureau of Standards with the assistance and advice of manufacturers, distributors, representatives from the American Institute of Architects, from the Federal Supervising Architect's Office, and from sash and door manufacturers' associations. These specifications, published as Bureau of Standards Circular No. 164 and United States Government Master Specification No. 123, represent the first comprehensive specification for glazing glass.

The detailed requirements of the specification do not lend themselves readily to briefing, but the requirements cover thickness, weight, and quality, as evidenced by waves, lines, cords, seed, stones, and other defects that would mar visibility.



Regenerative Furnace for Glass
This furnace can melt 5,000 lb. of glass in one charge. The pot shown contains about 1,000 lb.

Power Generated from Process Steam Yields Large Profit

By using a bleeder turbine, wool-scouring plant gains nearly 100 per cent on investment yearly

By William R. Johnson
Chief Engineer, Eavenson & Levering Co.
Camden, N. J.

OUR STEAM requirements are so large that we have been able to use our turbine generator equipment to take care of our electric load with considerable profit to ourselves. Our business is wool scouring and carbonizing and we handle, in our plant, from 35,000,000 to 50,000,000 lb. of wool per year. Steam is used for drying and carbonizing the wool. The electric load is made up of motor drives for pickers, openers, driers, scourers, etc. Our problem has been to carry both these loads with one plant with as little expense as possible.

In December, 1920, we installed our present power

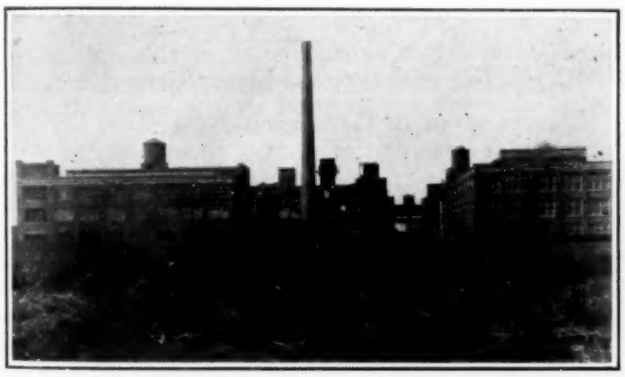


Fig. 1—Plant of the Eavenson & Levering Co., Camden, N. J.
The power plant, stack and condensing water coolers are shown in the center, between the two manufacturing buildings

plant, consisting of a 750-kw., 3,600-r.p.m. turbine, direct connected to a 750-kw., 440-volt, 2-phase, 60-cycle generator, with two surface type condensers, both the turbine and generator being of General Electric manufacture. The boiler equipment is in two batteries, the first being two 400-hp. Keeler water-tube boilers supplying us with steam for the turbine, wool drying and heating in winter, and also helping the other battery of boilers occasionally. These boilers operate at 200 lb. pressure and 100 deg. F. superheat. The second battery of boilers consists of two 175-hp. and one 150-hp. return-tubular Coatesville boilers which are used for wool carbonizing.

We formerly had two plants, in the older of which we generated power as well as steam for all purposes. In the newer plant we formerly purchased power at an average cost of $3,500 per month. In 1920, when we installed the turbine equipment in the new plant, we combined both plants in one.

The average load on the two 400-hp. boilers for power, wool drying and plant heating varies from 12,000 to 16,000 lb. of steam per hour during the summer, to 20,000 to 30,000 lb. of steam per hour during the winter. This means that, in winter, these two boilers are developing 1,000 hp.

Of this load, approximately 3,000 lb. of steam per hour at 10 lb. pressure are taken from the first stage of the turbine for wool drying. This load varies, of course, with the amount of wool being dried. During the winter, from 12,000 to 15,000 lb. of steam per hour, also at 10 lb. pressure, are required for drying wool and heating the buildings. On unusually cold days the

Cost of Operation—Turbo-Generator Plant

Depreciation of equipment including turbine, generator, switchboard, condensers, wiring, piping and installation—$40,000 ÷ 10 years	$4,000
*Average interest at 6% — $\frac{11}{10} \times \$40{,}000 \times \frac{.06}{2}$	320
Allowance for maintenance and repairs (Est'd)	100
Lubrication—65 gallons oil @ 40c	26
†Total annual cost of operation	$5,446

Saving Effected by Plant

‡Saving due to by-product power— $3,500 per month × 12 months	$42,000
Less annual operating cost	5,446
Net annual saving	$36,554

*Allowing for interest earned by depreciation reserve.

†Does not include attendance labor.

‡This saving takes into consideration attendance labor. The actual saving is greater than as stated because in combining the two plants, services of two boiler room operators were dispensed with.

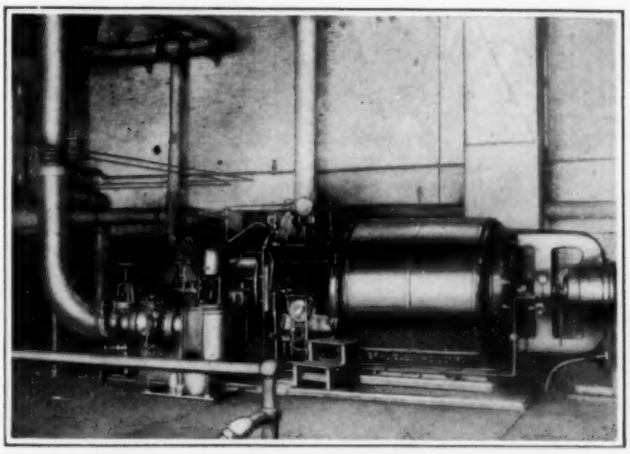


Fig. 2—The Bleeder Turbine and Electric Generator
An hourly extraction of 3,000 lb. of 10 lb. per sq.in. steam from this turbine takes care of the wool drying

steam consumption will run as high as 20,000 lb. per hour.

The electric load varies from 500 to 600 kw. with a 72 per cent power factor, the current varying from 850 to 950 amperes. We supplement this generating equipment with a 100-kw. electric service which is used to help carry peak loads and for week-end shut-downs. Our operating time is from Monday morning to Saturday morning.

From test runs at the old plant, purchasing outside electric power and using boilers to furnish steam for drying wool, heating of water and buildings, we found it took 85 per cent of the amount of coal that it did to generate our power using the exhaust steam for drying and heating. Because of the peculiarities of our business requiring a large amount of hot water and low-pressure steam, we get our electric power almost as a by-product by using the bleeder turbine, and we are able to start with steam at a temperature of about 500 deg. F. and, when done with it make it into hot water at a temperature about 120 to 160 deg. F.

The surface condensers maintain from 22 to 25 in. of vacuum during the summer and from 27 to 29 in. of vacuum during the winter; the amount of steam going to the condensers varies with the steam load so that, when steam is required for heating the plant during the winter, a smaller percentage of steam reaches the condensers. Water for condensing purposes is supplied from wells, from 300 to 400 gal. of water per minute being the average requirements. The water enters the intake of one condenser at 55 deg. F., coming back at, approximately, 100 deg. F. in summer and 80 deg. F. in winter. A cooling tower is used with the other condenser.

Our cost records show that we did not increase our coal consumption above what it had been in the two plants, although we are carrying the combined loads of the two plants and are generating all of our own power except for a small week-end and peak-load service. The $3,500 per month that we formerly paid out for power has become, therefore, a clear gain. In combining the two plants we were also able to dispense with the service of two power-plant operators, thereby effecting an additional saving.

In processing approximately 27,000,000 lb. of wool per year, 10,000 to 12,000 tons of soft coal are consumed. The saving due to by-product power is approximately $3,500 per month, without taking into account the cost of operating the turbine plant. After deducting all operating expense connected with the turbine generator equipment, we show a net annual saving of $36,554 per year or a return of more than 91 per cent on the investment, which we regard as very satisfactory.

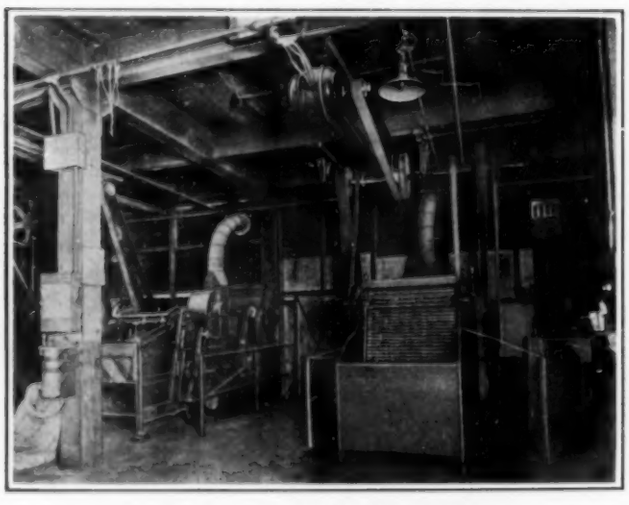


Fig. 3—View in the Picker Room
This picture gives an idea of the type of electric load occurring in a wool-scouring plant

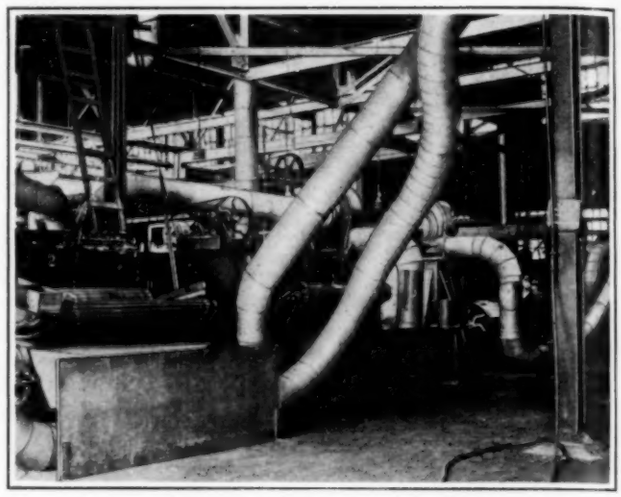


Fig. 4—View in the Wool-Drying Department
Exhaust steam is used in this room for drying 35,000,000 lb. of wool or more per year

How Coke is Distributed

Figures given in the accompanying table show the quantity and value of coke going to each of the major consuming fields. These figures are for 1924, the last year for which full statistics are available. It is interesting to note that, of the total value of coke produced, $244,041,561, approximately 75 per cent, or $187,569,185 worth was used for blast furnace and other furnace work. This clearly shows the importance of the prosperity of the steel industry as a determining factor in the coke oven industry. Of course, abnormal conditions, such as the present anthracite shortage and consequent increased use of coke as domestic fuel, temporarily upset this relation.

	By product	Beehive	Total
Ovens in existence Jan. 1, 1924	11,156	62,349	73,505
Ovens in existence Dec. 31, 1924	11,413	60,432	71,845
Coal charged into ovens:			
Net tons	49,061,339	15,914,310	64,975,649
Value	$202,428,797	$35,363,608	$237,792,405
Coke produced:			
Net tons	33,983,568	10,286,037	44,269,605
Value	$195,690,009	$48,351,552	$244,041,561
Average yield of coke from coal:			
Per cent	69. 3	64.6	68.1
Coke used by operator in blast furnace or affiliated works:			
Net tons	24,023,933	1,574,037	25,597,970
Value	$125,838,387	$7,872,356	$133,710,743
Disposal of coke:			
Sold for furnace use to affiliated corporations:			
Net tons	2,335,056	3,582,004	5,917,060
Value	$13,495,287	$17,706,496	$31,201,783
Merchant sales of furnace coke:			
Net tons	1,590,983	3,357,433	4,948,416
Value	$9,149,521	$13,507,138	$22,656,659
Sold for foundry use:			
Net tons	1,553,849	1,363,952	2,917,801
Value	$13,425,334	$7,543,143	$20,968,477
Sold for domestic use:			
Net tons	2,812,771	139,886	2,952,657
Value	$20,063,417	$509,333	$20,572,750
Sold for industrial and other use:			
Net tons	1,556,175	260,046	1,816,221
Value	$11,854,698	$1,052,249	$12,906,947
Screenings and breeze produced:			
Net tons	2,950,810	375,130	3,325,940
Value	$6,179,427	$1,298,854	$7,478,281
Screenings and breeze sold:			
Net tons	536,037	32,190	568,227
Value	$1,491,475	$75,111	$1,566,586

Systematic Outline of Chemical Literature

Classification of the various sources of published information relating to chemical science and technology

By M. G. Mellon

Assistant Professor of Quantitative Analysis, Purdue University

IN MAKING a systematic study of the literature of chemistry and chemical technology some classification is needed for the numerous and extensive sources comprising the published information relating to the science. Although it is probably impossible to formulate a scheme that is generally acceptable, it is evident that the material may be classified, either according to the nature of the subject matter, as is done in *Chemical Abstracts*, or according to the nature of the publication in which the information appears. This second basis of classification seems the logical one to adopt for the use of those who want practical assistance in using a chemical library, since periodicals and books are the units of the library and are the containers of the desired information.

The following arrangement, then, is one of publications rather than one of information. The two bases of classification, however, are combined, in a way, since there is included a statement of the kind of information which each type of publication contains. Although an attempt has been made to define the different classes of publications so as to make them properly inclusive and exclusive, it should be understood that in general, the different sections are not considered as differentiated from each other by a sharp line of demarcation. There is, on the contrary, more or less overlapping and gradual merging from one to the other. The scheme is also necessarily affected by whatever peculiarities individual choice brings into such work.

Publications can be divided into those containing original contributions and those involving compilations of facts already recorded. The original contributions can be further distinguished as being composed essentially of unorganized material, while the compilations are more or less organized, and are arranged according to some definite plan. The papers published by the various chemical societies throughout the world are new material, and the physico-chemical constants in the tables of Landolt-Börnstein are systematic compilations of facts previously known but so widely scattered as to be of little use unless collected. The material included under the two main divisions has appeared in a variety of publications and the subdivisions indicated have been made on the basis of the types of material appearing in these publications.

The various terms adopted have been used in accordance with the meaning given, in the standard dictionaries. This does not always agree with past usage. Our use of the word "handbook," for example, is quite different from that for the German "Handbuch," as applied to the works of Abegg and Gmelin-Kraut. Likewise, divergence is found in the use of other words, such as "dictionary," "compendium" and "textbook."

This outline is concerned primarily with those publications which have been issued since 1665, the beginning of the publication of the *Philosophical Transactions* of the Royal Society. It is, of course, well recognized that many facts now called chemical were more or less common knowledge far back in the history of civilized man. Information regarding these facts occurs in various records available relating to the prehistorical, alchemical and iatrochemical periods in our chemical history. Certain books of Pliny's "Historia Naturalis" purport to be a record of the known chemical facts of the time. We find also other interesting and much later works, such as "Artis Chemiæ Principes" and "Bibliotheca Chemica Curiosa," along with several others. It is doubtful, however, if these works, written before the application of the experimental method by Robert Boyle, are of much value today except to the chemical historian. Many facts stand out as accurate observations of the early workers; but the records of their processes are meager, and the recipes of the alchemist are often misleading, mysterious and inaccurate in the light of our present knowledge.

If one wishes to consider details, the outline presented may be expanded as desired by making further subdivisions on the basis of the various branches of chemistry. The 30 divisions used in *Chemical Abstracts* form the best scheme for detailed work. Such consideration would apply particularly to the sections on general works of reference and textbooks, and possibly to the sections under journals; but the advantage is not so apparent in the case of bibliographies, patents, dissertations, and similar publications.

General Outline

A.—Original Sources (unorganized information).
Publications containing new material or new presentations and discussions of known material. They constitute the latest published information.

I.—Periodicals
Material that varies widely in character but generally includes original papers, together with one or more of the following items: addresses, review articles, editorials, proceedings of meetings, news items, notes of new books and government publications, market reports, trade announcements, and advertisements.*

1.—Journals of General Science
Devoted to various fields of science, including chemistry.
e.g., *Trans. Roy. Soc., Am. J. Sci., Compt. Rend.*

2.—Journals of Non-Chemical Sciences
Devoted primarily to fields other than chemistry but contain chemical articles as incidental contributions.
e.g., *Phys. Rev., Engineering, Eng. News-Record.*

3.—Journals of Chemistry
Devoted primarily to chemistry and chemical technology

a.—General
Devoted to various phases of the science.
e.g., *J. Am. Chem. Soc., J. Chem. Soc., Ber., Bull. soc. chim.*

b.—Specialized
Devoted to special divisions, such as physical, organic, industrial, or other limited fields.
e.g., *J. Phys. Chem., Ann., Kolloid Z., J. Soc. Chem. Ind.*

II.—Contributions of Institutions
Material usually issued irregularly as separate bulletins or pamphlets. Generally new but occasionally composed of compilations and summaries.

1.—Public Documents
Reports of the work done in the various governmental scientific bureaus, laboratories and experiment stations.
e.g., Bulletins of the U. S. Bureaus of Standards, Mines, and Chemistry, and of the State Experiment Stations; The German Technische und Physikalische Reichanstalt; and the British National Physical Laboratory.

2.—Reports of Non-Governmental Institutions

*Note—Occasionally all the contributions of an individual are reprinted and bound together, as, for example, the works of Emil Fischer.

Reports of scientific projects financed wholly or in part by privately endowed institutions.
e.g., Richards and Forbes, *Carneg. Inst. Pub.* 56.

III.—Literature on Patents
Information regarding new patents issued, or concerning those subjected to action in the courts or in the patent offices.

1.—Periodicals
Summarized or abridged information regarding the object patented.

a.—General abstracting journals
Abstracts of patents, in addition to other abstracts, including the name of the patentee, number of the patent, country, date, and the general nature of the patent. Often the only information published in a chemical journal.
e.g., *Chem. Abs., Chemistry and Industry.*

b.—Journals on Industrial Chemistry
Notices, abstracts, or reviews of the more important patents. Occasional discussions of matters of general interest in patent practice.
e.g., *Chem. Met. Eng., Chem. Age* (London), *Chemistry and Industry.*

c.—Special Journals on Patents
Material devoted exclusively to patents, designs, trade marks, and matters relating to them.
e.g., Official publications of the various patent offices—*Die Patentberichte.*

2.—Letters Patent Documents
Copies of the original patents, including the specifications and claims.
e.g., U. S. Letters Patent No. 1647—Improvement in Electromagnetic Telegraph.

3.—Court Records
Records of decisions and rulings relating to matters such as patentability, infringement, interference and injunctions.
e.g., Decision in U. S. District Court (N. Y.) in the case of the General Bakelite Company against the General Insulate Company.

IV.—Miscellaneous Contributions
New material not included in previous sections.

1.—Dissertations
Separately published, detailed accounts of research work conducted by students for advanced academic degrees. Abridgements at least are usually published as a regular article in some periodical.
e.g., R. E. Lee, a "New Precision Method for Determining the Densities of Liquids," New York, 1913.

2.—Manufacturer's Technical Bulletins.
Circulars and pamphlets dealing with the construction and use of new apparatus, appliances, materials and processes, often including short bibliographies.
e.g., *Catalog* 48, Leeds and Northrup Co.
—"Apparatus for Measuring the Conductivity of Electrolytes."

B.—Secondary Sources (organized information)
Publications containing information compiled from one or more of the preceding classes and arranged according to some definite plan.

I.—Periodicals and Serials
Compilations or digests of the material appearing in the original sources—more or less frequent and generally regular in time of appearance.

1.—Abstracting Journals
Contemporaneous, concise summaries of each published article, including author's name, title of article, and original reference. The journal may be devoted entirely to abstracts or be composed partly of abstracts and partly of original papers.
e.g., *International Catalogue of Scientific Literature* Part abstracts, *J. Chem. Soc., Chem. and Ind.*

2.—Index Serials
Compilations of references only, including author's name, title of article, and original reference.
e.g., *International Catalogue of Scientific Literature —Repertorium der Technischen Journal Literatur, Industrial Arts Index, Engineering Index.*

3.—Review Serials
Accounts of the developments in various fields for some given period of time, usually a year, compiled from the more important papers, often including original references.
e.g., Liebig and Kopp's *Jahresberichte, Chemical Reviews, Annual Reports of the Chemical Society, Science Progress.*

II.—Bibliographies
Lists of the most important or complete references relating to some given subject, usually arranged chronologically or alphabetically by authors. Published as separate contributions or as a part of some article involving the subject in question.
e.g., Van Patten, "Bibliography of the Corrosion of Metals."

III.—General Works of Reference and Textbooks
Works covering all or part of a given division of chemistry, the material included having been selected from the various original sources and arranged in some definite manner. Since such works are not published frequently, the information in many cases is obviously not up to date.

1.—Works of Reference
Works ranging from specialized, limited presentations to the comprehensive and exhaustive treatments involving a whole field.

a.—Indexes and Catalogs.
Compilations of names, formulas, etc., so arranged that references to a given subject may be found as easily as possible.

a:—Card Indexes
Indexes in which each item is entered on a separate card, and the cards arranged by subjects, authors, or alphabetically. They are unpublished and not widely accessible, but readily adaptable.
e.g., U. S. Patent Office Index, Card Index Catalogues.

b:—Indexes in the Form of Books
Indexes published to cover their field to a given date.
e.g., Hoffmann, "Lexikon der Anorganische Verbindungen;" Trade Catalogs, Dealer's Trade Lists, Lists of Patents.

b.—Treatises and Handbooks
More or less exhaustive surveys of the information in given fields.

a:—Compilations alone
Tabular data, such as physico-chemical constants, with or without original references.
e.g., Olsen's "Chemical Annual," "International Critical Tables," Landolt-Börnstein, "Physikalisch-Chemische Tabellen."

b:—Compilations combined with critical discussion
Extensive or complete presentation of the material of a given field, based upon some general outline such as groups of elements or classes of compounds, usually including the more important original references.
e.g., Mellor, "Comprehensive Treatise on Inorganic and Physical Chemistry;" Beilstein, "Handbuch der Organischen Chemie;" Abderhalden, "Handbuch der Biochemischen Arbeitsmethoden."

c.—Dictionaries and Encyclopedias
Generally comprehensive summaries of the whole field or a large, representative portion, with or without original references, in the form of separate discussions of the various topics, usually in alphabetical order. (A dictionary, strictly speaking, contains the words belonging to some province of knowledge, as Couch's "Dictionary of Chemical Terms.")
e.g. Thorpe, "Dictionary of Applied Chemistry," Ullmann, "Enzyklopödie der Technischen Chemie."

2.—Monographs
More or less exhaustive presentations of our present knowledge of a limited field, usually in the form of a series of works under a general editorship but by individual authors.
e.g. Monographs of the Am. Chem. Soc., the British series on biochemistry, on inorganic and physical chemistry, and on industrial chemistry.

3.—Textbooks
Manuals of instruction, usually single volumes on special phases of a subject, arranged to be representative of principles rather than exhaustive in their treatment.
e.g. Blasdale, "Principles of Quantitative Analysis."

Manufacture and Application of a New Mineral Adsorbent

How Filtrol was commercially developed as an aid in the refining of mineral, vegetable and animal oils

Contact filtration has been one of the outstanding developments in the Californian petroleum industry in recent years. With this development has come the interesting use of a certain type of raw mineral material for the manufacture of a refinery aid of unusual characteristics. The result has been a considerable simplification of refinery practice, which has been extended to the vegetable, fish and animal oil industries with equally successful results. Increased attention to the potentialities of the new adsorbent has served to stimulate further research, the result of which has been a steady increase in the efficiency, per unit of weight, of the decolorizer and a consequent cheapening in the cost of refining. More recent developments indicate that its use may obviate the customary acid and alkali treatment formerly considered an essential step in the refining of petroleum products. Further economies in application are due to the discovery of the practicability of repeated contact of oil and decolorizer before exhaustion of adsorptive properties, and the ease with which the material may be reactivated.

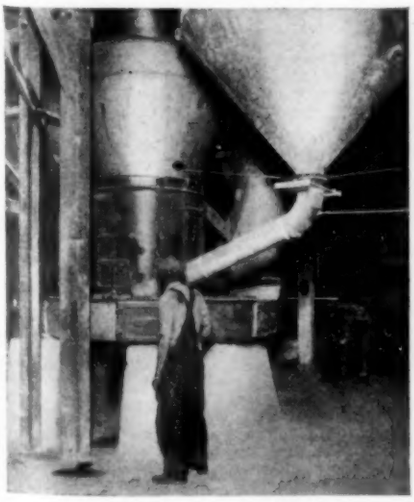
EARLY in the development of any industrial enterprise it is essential that an adequate reserve of raw material of the requisite characteristics be located in order that absolute reliance could be placed by the user of the product on its uniformity and efficiency at any future date. Preliminary laboratory work indicated that ordinary sedimentary earths would not satisfactorily serve as a raw material for the manufacture of an activated adsorbent for use in oil refining. Chemical analysis offered no guide as to ultimate decolorizing efficiency since similar samples of uniform composition were found to give widely variant results. This discovery finally led the Filtrol Co. of Los Angeles, California, to an elaborate program of prospecting, and the examination of more than 1,000 samples of raw material received from various parts of the United States and foreign countries. Certain properties were selected and acquired; and as a result the Filtrol Co. now owns three deposits of the required physical characteristics, and an adequate supply is assured.

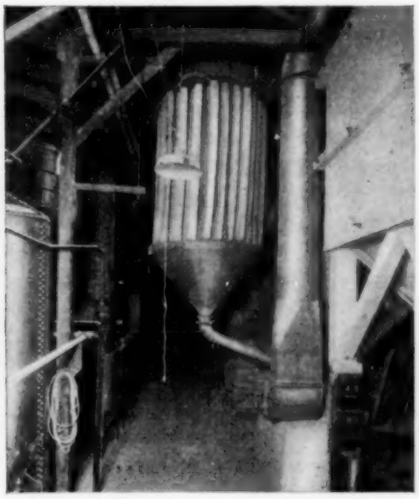
Having obtained its raw material the next step was the development of a continuous process for manufacturing the new adsorbent, which is known by the trade name, Filtrol. The usual difficulties associated with an effort of this kind were met but in the main success was achieved by the utilization, in large part, of the work of pioneer cyanide-process engineers, who initiated the methods and developed most of the apparatus finally adopted.

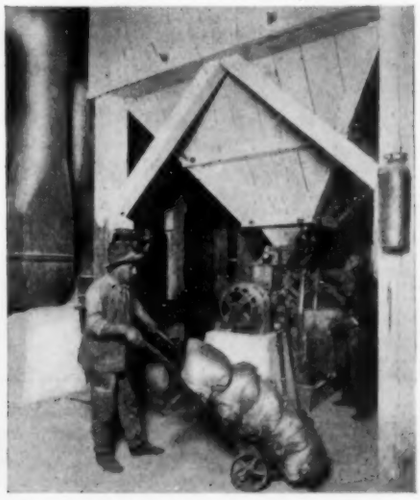
The raw material is shipped in gondola cars from the company's deposits and delivered to belt conveyors at the plant, by which it is carried to a primary crusher that reduces it to about ½-in. From a storage bin it is delivered to a feeder belt equipped with an ingenious though simple provision for insuring constant flow of a predetermined amount, which is carried by belt-and-bucket elevator to a mixer, where a fine pulp is made with water. A classification then follows, whereby undesirable material is removed and rejected. The overflow from the classifier goes to closed reaction vats, the necessary amount of chemicals being added automatically. A special method of agitation with air and superheated steam is used, the extended treatment serving to effect a complete change in the chemical and physical properties of the raw material.

Displacing Dissolved Salts

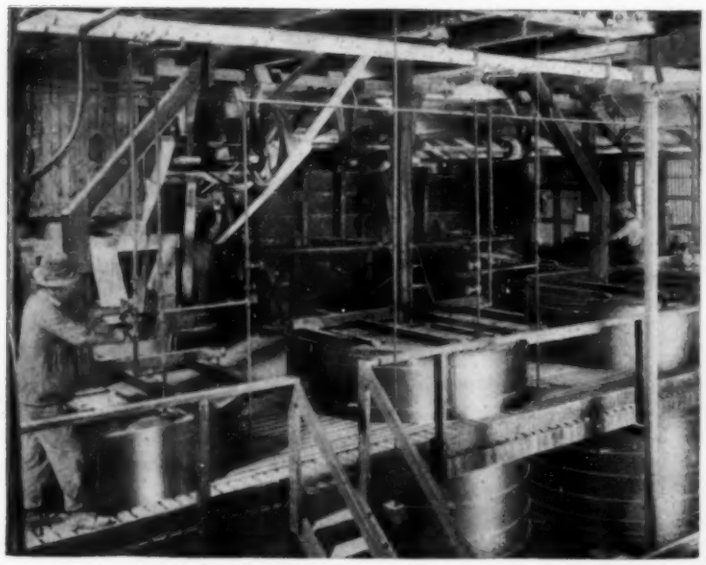
Six thickeners are used to effect a primary separation of the solid from the liquid constituents of the pulp and to wash the product, the flow of pulp from vat to vat being maintained by means of diaphragm pumps. From the last thickener the pulp flows by gravity to a continuous vacuum filter, where its moisture content is reduced to about 45 per cent. The discharged cake is then delivered, by screw conveyor, to a cylindrical drier, where the moisture content is further reduced. From the drier, the product passes by belt conveyor to a storage bin, from which it is fed, as required, into a mill, with air classification, giving a final product of which 99 per cent passes a 200-mesh screen. A storage bin is arranged above an automatic sacking and weighing machine, which delivers 50 lb. net of Filtrol to a special type of paper bag, of Bates multi-wall type. For

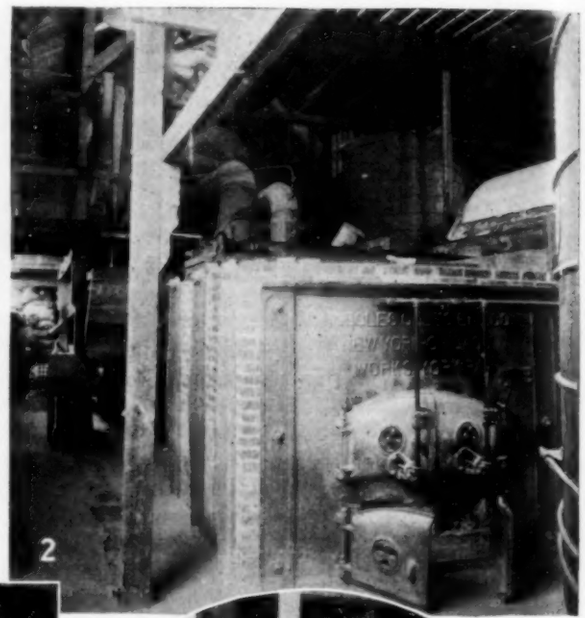


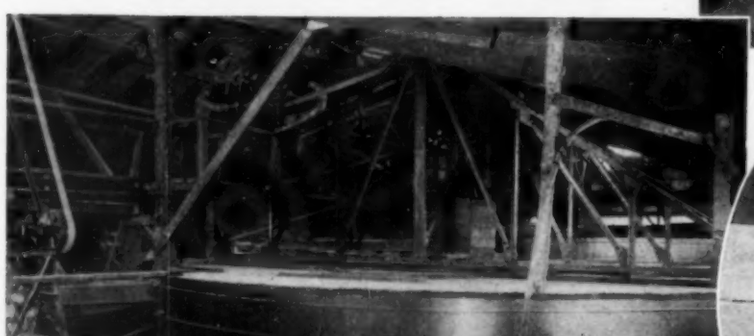


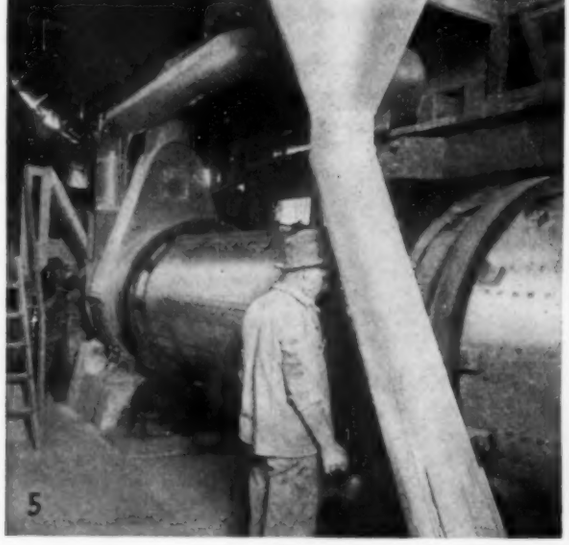


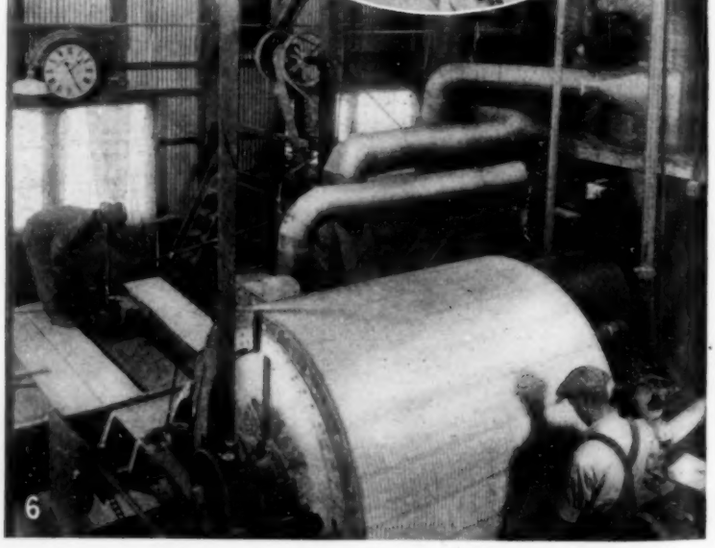
At left—The Mill That Reduces the Product to 200-Mesh. Center—Baghouse Plant Used in Conjunction with the Mill. At right—Automatic Sacking and Weighing Machine











Six Stages in the Manufacture of Filtrol, a New Mineral Adsorbent Material

Fig. 1. A view on the mixing floor, showing the steam-heated reaction vats in the foreground. Fig. 2. The fire-door end of the revolving drier. Fig. 3. One of the six Dorr thickeners used for counter-current washing of the treated mineral. Fig. 4 The raw material, as it enters the manufacturing process is carried by belt-and-bucket elevator to the first mixers. Fig. 5. The drier and dust-collecting equipment. Fig. 6. Oliver filter used for dewatering the underflow from the last Dorr thickener.

shipments abroad, an exterior burlap bag is used in addition to the paper bag, although the latter is amply strong enough for rail and local delivery.

In spite of the frequent handling in so many different operations of an excessively finely divided and light material, the plant is well-nigh dustless. This condition is insured by the provision of an elaborate system of suction fans and collecting equipment, the dust being returned to the circuit.

Motive power is by electric drive throughout, being developed by 24 direct-current motors, of 5 to 40 hp. apiece. A 50-hp. boiler is used to supply steam, the water being treated beforehand in a water-softening unit. In addition to the equipment already mentioned, two Rix compressors supply air for the agitators, vacuum filter and for other uses around the plant and in the laboratory.

A complete system of technical control of plant operations is in practice. In addition to the sampling and examination of hourly samples of the treated but unwashed pulp before it enters the thickeners, each lot of five bags of the finished product is sampled, and a composite test made for decolorizing efficiency and chemical reaction. Moreover, each lot of 200 bags is given a serial number corresponding to the record kept in the laboratory of the average of the test made thereon.

Industrial Applications

Research work in connection with the application of Filtrol has been complicated by the ever-broadening field of utilization; and at the present time records are available of its successful use as a decolorizer and clarifier of a large number of vegetable, animal and mineral oils. Recent research has demonstrated its availability in the vapor-phase treatment of benzol and cracked distillates. Gasoline, benzol and other dry-cleaning fluids can be restored to their original clarity and efficiency by a somewhat similar treatment with a special type of Filtrol.

The highly adsorptive powers of the product—it is from 3 to 7 times more efficient than any one of the various earths previously used—is more than sufficient to counterbalance the increased cost of preparation. Because of the high degree to which its adsorptive capacity has been developed, the oil adsorption loss are small due to the small amount of the new decolorizer necessary. Moreover, the special treatment given results in a permeability that insures quick and efficient filtration; and in consequence, increased capacity from filtering units.

The introduction of a method of progressive contacts and filtrations in two or more stages has also resulted in effecting considerable economies. Single-contact filtration, it has been found, usually leaves the adsorbent in a partly exhausted condition only, and in practice it has been found economical to use it over again for the preliminary decolorizing of more oil. A counter-current system of treatment has been developed, whereby the partly spent Filtrol comes into contact with crude oil, and the partly clarified oil comes in contact with fresh adsorbent, resulting in maximum effect with minimum quantity of decolorizer.

In the refining of petroleum products, increasing attention is being deflected to the fact that the customary methods of treating oils—by acid refining, neutralization with caustic and percolation through coarse earth, with the use of a solvent to lower cake loss—are uneconomical and inefficient. By using Filtrol, the neutralization phase in the treatment of acid oils may be avoided entirely; or acid treatment itself may be avoided and initial contact made with once used partly spent material, with or without the addition of a small amount of acid. The filtered oil is subsequently contacted with fresh adsorbent.

The scope for research in this new field of technical activity is evidenced by the fact that refinements in processing in recent months at the Filtrol plant have resulted in an increased efficiency of from 30 to 40 per cent. For example, whereas 10 lb. was used formerly, only 7 lb. is now necessary to obtain the same result. Attention is being paid also to the physics and mechanism of reactivation, which is an important phase of the subject. One shipment of Filtrol has been reactivated 17 times, is still in use and showing maximum decolorizing efficiency.

Sugar from Corn

Development of crystallized dextrose stimulates corn-products industry

RECENT agitation in the corn-growing states of the Middle West in the interest of increasing the consumption of corn has served to call attention to a development in the corn-products industry of first-rate importance from a technical as well as commercial viewpoint. The recovery of dextrose from commercial glucose (corn syrup) by crystallization from a water solution was developed during the War but only within the past two or three years has it been carried out on a scale sufficient to make crystallized dextrose an important commodity of commerce. It is estimated that the present production of crystallized dextrose is in the neighborhood of 500,000 lb. per day as the result of recent increase in manufacturing capacity.

Corn sugar, i.e., the crystallized dextrose, can be produced at a lower cost than cane or beet sugar. The present price, according to a statement made in a recent Congressional hearing, is $4.50 per 100 lb. as compared with $5.50 for cane sugar. Crystallized dextrose is sold in various granulations and by appearance alone can scarcely be distinguished from the familiar grades of refined sugar. Corn sugar is not as sweet as cane sugar, however; the relative sweetness of crystallized dextrose, sucrose and levulose is in the approximate order of 70, 100 and 175. For certain uses, such as in canning where the amount of sugar required for preservation sometimes gives an excessive sweetness to the product, corn sugar is said to be a superior product. It is largely used in the manufacture of ice cream, in baking, and in the making of jellies, preserves and similar products. The exact tonnage of sugar that is used for canning and preserving and, therefore, the potential market for corn sugar is not known, but some have estimated it to amount to as much as a million tons per year. Others would place the consumption at a much lower figure.

The present production of corn sugar accounts for approximately 6,500,000 bushels of corn. It is produced by the Clinton Corn Syrup Refining Co., Clinton, Iowa, and at plants owned by the Corn Products Refining Co., the American Maize Products Co., and Penick & Ford. The three latter companies have their principal offices in New York City.

Rosin Production Lacks Flexibility

Seasonal character of present naval stores industry makes variations in gum output a practical impossibility

By L. R. Potter
Columbia Naval Stores Company, Savannah, Ga.

THE outstanding feature in naval stores this year has been the unusually high prices of rosins. With the exception of the abnormal levels reached during the War and for a short period immediately following, prices during the current season have been the highest in the recollection of the trade. Prior to the War, the American production of gum rosin was somewhat in excess of 2,000,000 round bbl. of approximately 500 lb. Europe in pre-war days was the largest customer for American rosins. The total foreign exports exceeded to quite an extent the domestic consumption. During the war period, American industries, stimulated by the increased production of war supplies, absorbed the surplus production which would ordinarily have been accumulated due to the lack of European consumption. Furthermore, because of labor conditions the war-time production was reduced considerably below that of the pre-war supplies. Shortly after the War the American industries returned to a more normal consumption and as Europe was in a more or less chaotic state industrially and financially, the industries there were able to take only a small portion of their pre-war volume. Improved labor conditions brought about an increase in the American gum production of rosin and the annual output improved but did not reach the pre-war average. The average annual post-war crop being in the neighborhood of 1,700,000 bbl. During the time shortly after the cessation of hostilities, the surplus stocks in America rapidly increased, and as a result, rosin prices for several years were on a very low basis; and as a matter of fact were under the 5-yr. average prior to the war. As Europe gradually began to pull itself together, its consumption began to increase and the total exports last season were slightly over 1,400,000 bbl. of rosin. Last season's domestic consumption was estimated at somewhat over 800,000 bbl. giving a total consumption both domestic and foreign of something over 2,200,000 bbl. of rosin. Last season's production of wood rosin is estimated at approximately 250,000 bbl. and this, together with an estimated gum production of 1,700,000 bbl., would indicate a total production of both gum and wood rosin of 1,950,000 bbl. It is, therefore, obvious that the consumption exceeded the production by a very large amount and brought reserve stocks which had been greatly depleted for some time, down to very small proportions. The production of gum rosin during the current season has been slightly less than that of last year, some estimates placing the reduction in the entire crop at in the neighborhood of 10 per cent. Some little increase in the production of wood rosin is estimated but this is considered to be so small as to be almost negligible. So far this season, although there has been some slight decrease in exports, it is not thought that there has been any substantial decrease in consumption, and it is believed that any slowing up in the movement of rosin has been large due to the policy of carrying only small stocks at the high prices which have prevailed this year rather than to any reduction in consumption.

Turpentine, although higher than pre-war average values has not been affected to the same extent by the conditions which have governed the rosin market. American industries have always consumed the larger part of the turpentine output, and although in recent years improved business conditions throughout the world have brought about a largely increased demand for the products in which turpentine is used. The increased use of lacquers and substitutes have to a large extent offset these improved business conditions so far as turpentine is concerned. It is too early to forecast with any degree of accuracy the outlook for next season as this depends entirely on two main elements which are yet unknown—production and consumption. Indications at present are that very little increase, if any, can be expected so far as production is concerned. Labor in some sections of the belt, particularly in the State of Florida where this year's crop was materially reduced, is still hard to obtain and with the building improvement and road making which give every evidence of continuing, there is very little on which to base one's hopes that the labor situation will improve during the coming season. On the other hand, it gives every indication of becoming more of a problem than at present. So far as consumption is concerned, at this time there appears no signs of any impending trouble of any consequence on the business horizon, and unless conditions should change greatly, there is every reason to believe that the consumption during 1926-1927 season will be satisfactory, although high values may, of course, curtail it to some extent.

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Byproduct Coke Plants in 1925

Although no accurate estimate of the maximum coke oven capacity can be made until further returns are received by the government, it is apparent that in 1925 the production of byproduct coke represented nearly 85 per cent of the installed maximum oven capacity. This percentage is approximately the same as was used in 1923. It represents almost the upper limit of actual production that is possible. Breakdowns, local shortage of labor, of coal, or of immediate market, and other unavoidable causes of reduced output make it practically impossible for the industry as a whole to operate above 90 per cent of its rated capacity for an entire year. Single plants can often exceed this figure but they rarely exceed 92 to 94 per cent of their rated capacity for similar reasons.

Growing Market for Vegetable Oils in Paint and Varnish Industries

How linseed, china-wood, rapeseed, soya-bean and perilla oils are marketed to the principal consuming trades

By Martin F. Austin
Vegetable Oil Department, W. R. Grace & Co., New York City

LINSEED oil is obtained from seeds of the flax plant grown largely in the Argentine, the United States, Canada, Russia, India and Manchuria. The oil content varies from 30 per cent to 42 per cent according to the origin of the seed and varying climatic conditions during each growing season. A world average of 35 per cent is a fairly safe calculation. Pressed oil is capable of refining, and in Europe is used for edible purposes. Most of the oil is produced by expression, as the hot pressed cake and meal is valuable as cattle feed. Damaged seeds are frequently used in the extraction method but the resultant cake is used only as fertilizer. Linseed oil is used to some extent in making soaps, particularly soft soaps in Europe, but its high iodine value—from 170 to 193—makes it particularly valuable in the making of paints and varnishes, putty, and such products as linoleum.

MARKETING

In a preceding article in the Marketing Series, Mr. Austin, who writes with authority gained from long experience in the handling and marketing of vegetable oils, discussed the oils that enter into the soap and food-products industries. His discussion is concluded with the present treatment of the oils that are used in the manufacture of paints and varnishes—an important outlet that in recent years has had a remarkable growth.

CHEMICAL PRODUCTS

The greater part of the oil is sold as raw, but there is a growing importance to the volume of boiled, double boiled and especially prepared oils for the various kinds of paints, varnishes, enamels, etc. The large crushers have their own tank and distributing stations scattered over manufacturing centers from which deliveries are made in tank wagons, drums and barrels to suit requirements of buyers. Before the advent of the present tariff of 3.3c. per lb., we imported large quantities from Europe but the current rate of duty practically prohibits all imports. We do, nevertheless, import many million bushels of flaxseed, on which a duty of 40c. per bu. is levied, to supplement our domestic production which is far short of our consumption requirements of oil.

This duty is, however, subject to a drawback, equivalent to the amount of duty paid on seed crushed in cake exported, which, in actual practice, works out to be about 10c. per bu. drawback on the entire amount of duty paid on imported seed. This is subject to slight fluctuations.

China-Wood Oil

China-wood oil known also as tung oil and nut oil is obtained from the nuts of trees common to China. The nuts are first placed in a large pan and stirred over a wood fire until parched, causing the husks to open and the seeds to be easily extracted. Sometimes the nuts, gathered before maturity, are covered with straw or grass, causing fermentation and easy extraction of the seeds, thus saving labor and fuel. After the husks are removed the nuts are ground in stone mortars into a fine meal. The heavy stone roller is turned by an ox, and this is followed by further pressing in crude hand presses. Not more than 40 per cent of the 50 per cent oil content is recovered. The oil is made in small quantities by a large number of producers from whom it is collected by merchants in interior points and brought to centers where it is purchased by firms who maintain agencies there. Transportation is attended with many difficulties and requires moving under convoy, subject to depredations by bandits, or is subject to a heavy levy by the several groups of militarists. From collecting centers the oil formerly was transported to Hankow in baskets in small native craft but now foreign firms operate large river boats during the high water season, March to October. The oil arrives in Hankow in crude condition and requires settling and filtering to remove extraneous matter. During high water seasons the oil may be shipped from Hankow in compartments of ocean steamers, direct to Europe and the United States. During the remainder of the year it must be shipped in small boats to Shanghai and there loaded in ocean steamers. Wood oil is used in China primarily as a natural varnish for boats, houses, furniture, waterproofing, material for oil cloth, paper umbrellas, etc. It is used by the natives also as an illuminant, giving off a smoking flame and irritating vapor. The smoke from this flame and that from burning of cake makes lamp black. The cake is poisonous. In the United States the oil is used in making varnishes, paints, linoleum, printing inks, etc. In some trades the price must be lower than linseed oil and soya bean oil to attract the buyer. For several years experiments have been carried on in growing tung trees in Florida, but production of the oil has not attained commercial importance.

The oil has pronounced drying properties and to protect buyers from the dangers of adulteration, especially prevalent when prices are high, tests have been adopted by large manufacturing consumers, by the principal importers, and by trade bodies. Tests of such chemists as Bacon and Worstall are accepted as to the

purity of the oil. The heat test is the best known. This requires the oil to be heated say to 540 deg. F. and if after 7 minutes the product cuts dry and firm, like bread, it is called commercially pure, subject to the oil conforming to other standards such as iodine value around 170, refractive index 1.5180 at 25 deg. C., etc.

Sales are made principally by importers and brokers to the manufacturing consumers, for from one week to six months forward, shipment from Atlantic and Pacific coast ports of entry, movement in tank cars.

Rapeseed Oil or Colza Oil

Rapeseed oil or colza oil is produced from seed grown largely in India and China and is in constant danger of admixtures of mustard, jamba and ravison seed. The seed contains from 33 per cent to 45 per cent oil which is obtained both by expression and extraction methods. Cake from expression methods is a good cattle food while that obtained by extraction is fit only for fertilizer. In this country "colza oil" denotes usually, an oil for burning, and is obtained from selected varieties of seeds. The technically refined oil when blown is used largely by lubricant manufacturers as flux in making rubber substitutes and when "blown" (with air) is now going into lacquer channels. Cold drawn or pressed oil is largely used as an edible oil in India and in Continental Europe.

Of the total American imports, nearly one-half goes to one prominent lubricant manufacturing company which purchases the oil through its English office and has it processed to conform to its own specifications. The remainder is distributed throughout the American trade as described above. Lubricant buyers, as a rule, require that the oil shall conform to specifications which are understood here in the trade as Texas Co., Standard Oil Co., and Sinclair Refining Co. These specifications bear close resemblance but in general require that the oil shall be pure and unadulterated, free fatty acids shall not exceed 1 per cent, iodine value shall not be lower than 97 nor higher than 103 (which by the way is unduly low according to the standards suggested by the American Society for Testing Materials and other authorities who admit the purity of rapeseed oil with an iodine value as high as 105), specific gravity shall be 0.916 to 0.910 at 60 deg. F., viscosity shall be 212 to 240 seconds (Saybolts Standard Universal instrument at 100 deg. F.), flash not less than 525 deg. F. open cup, pour test 0 deg. F.

Sales are made by importers and distributors to the various consumers and deliveries are made in barrels and drums. New York is the greatest port of entry but there are limited quantities entering ports of Boston, Philadelphia and San Francisco. Prices are quoted in cents per gallon, and the general commercial practice of 7½ lb. to the gallon prevails, although the United States Government recognizes a weigh of 7.64 lb. to the gal. The duty is 6c. per gal.

Soya Bean Oil

Soya bean oil is obtained from soya beans found in China, Manchuria, Japan, and, since introduced here, have been growing steadily in production in parts of North Carolina, Indiana and Illinois. While there are four varieties—white, yellow, green and black—the little yellow bean is the best known and the most prolific producer. The beans, the oil and the cake are important elements of the human diet in China and Japan. The oil was, until recent years, produced only by crude hand presses of stone, requiring a long time in operation, and this method still prevails to a large extent, notwithstanding the introduction of modern milling machinery at large centers like Dairen. The oil content of the bean is as high as 20 per cent but the yield is much less, perhaps not over 12 per cent average. The cake is used both for human and animal food but here it usually forms the basis of diabetic diets. When solvent extraction methods are used the resultant cake is used for fertilizer.

The oil is used for edible purposes, soap, cooking, compound lard, paint, linoleum, and some other minor purposes. It is semi-drying and can be substituted for linseed oil to some extent. For soft soap it will serve equally as well as linseed oil. It does not serve nearly so well for cottonseed oil in the edible or soap making industries and there must be an inducement of much lower price to bring about any real competition.

The principal grade of soya bean oil is pressed fair average quality maximum 2 per cent free fatty acids and ½ of 1 per cent moisture and impurities. However, if the oil tendered is merchantable and fair average quality of the season's production, it is deliverable on contract, seller making an allowance to the buyer at the rate of 1 per cent of the contract price for each 1 per cent free fatty acids in excess of 2 per cent, and 1 per cent additional for each 1 per cent moisture and impurities in excess of ½ of 1 per cent.

Refined and hydrogenated soya bean oil is usually sold on description. This has now become a specialty business, and the oil is processed to buyers' requirements. The same applies to the blown soya bean oil trade.

The present duty on soya beans is one-half cent per lb. and on the oil 2½c. per lb. In 1919 we imported as much as 244,000,000 lb. of the oil whereas in 1922 the amount brought into this country had declined to 3,800,000 lb., the falling off being due to our almost prohibitory import tariff of 2½c. per lb.

Perilla Oil

Perilla oil obtained from perilla seed grown in India, China, and Japan is a valuable substitute for linseed oil; particularly on account of its high iodine value. Its production, however, is so limited, it does not offer any real competition, as the small supply is absorbed readily on its own merits.

The seed contains from 35 per cent to 45 per cent oil of good drying power slightly inferior to linseed oil in this respect. In the Far East it is used to some extent for edible purposes and in Japan it enters largely into their lacquer manufacture.

Shipments are necessarily over a long period after the new seed comes on the market in Manchuria in November-December. Deliveries in barrels and drums, are made to the United States to importers who then distribute it to consumers in tankcars, or to smaller consumers in barrels and drums. Sales are effected, as a rule, through brokers who make a specialty of paint and varnish oils. Quality is usually described as fair average quality of the season but it is understood it shall be commercially pure. In late years there has been a development in the demand for a quality that will be absolutely non-break in the varnish kettle at 600 deg. F.; and when the oil is prepared from specially selected seed and the oil properly refined and filtered, this quality of non-break is available.

Recent Legal Decisions

Digest of typical cases decided in high courts, illustrating principles of law applied to business transactions

Rubber Accelerator Patent Held Invalid

In an opinion handed down early this month by Judge Gibson in the U. S. District Court at Pittsburgh, patent No. 1,411,231, granted to Morris L. Weiss, and assigned by him to the Dovan Chemical Corporation, for the use of diphenylguanidine as a rubber accelerator, was declared invalid. The decision was rendered in a suit of the Dovan Chemical Corporation vs. Corona Cord Tire Company.

The defendant admitted the purchase of diphenylguanidine and its use as an accelerator of vulcanization, but denied the validity of the patent. Application for the latter had been filed Nov. 12, 1921, and the patent was granted March 8, 1922. The defendant alleged that more than two years prior to the application for the patent Dr. G. D. Kratz had on Sept. 6, 1919, disclosed the subject matter of the patent in a paper read at a meeting of the American Chemical Society in Philadelphia (see *Chem. & Met.*, Oct. 1, 1919, page 430). The defendant further declared that in 1917 Kratz had produced and sold tubes made from a rubber mixture with diphenylguanidine as an accelerator. It was also contended that inasmuch as triphenylguanidine was early known to be an accelerator, no inventive faculty was required to assume that a closely related chemical would have similar qualities.

Testimony developed the fact that Weiss was employed by the Republic Rubber Co. in 1918-1919 in experimental work upon accelerators. The laboratory record book which Weiss was required to keep showed that prior to Sept. 7, 1919, he had made two experiments with diphenylguanidine, which were undisputed, and a third which showed a change of its original date and which the defendant claimed was subsequent to that date. The undisputed tests were with a shoddy mixture and showed no marked superiority of DPG over TPG. The disputed test was with new rubber and showed marked superiority. It was further shown that M. H. Daniels, the immediate superior of Weiss in the Republic Rubber Co., had attended the meeting of the A.C.S. when Dr. Kratz read his paper and had on the following day imparted to Weiss information and data disclosed by Dr. Kratz. Thereafter the laboratory book showed the use of DPG in a number of tests.

Weiss testified that he began to investigate DPG early in 1918 and had made a number of tests prior to February, 1919. These, however, were not recorded in the laboratory book. Of the three tests appearing under dates of the early part of 1919, two in connection with shoddy compounds are of little significance. The third, which appeared to have the date "2-10-19," showed on examination under a strong glass that the "2" was originally "9" making the date Sept. 10, 1919, four days after Kratz had read his paper and three days after the information then disclosed had been given by Daniels to Weiss. This, together with other inaccuracies and contradictions of statement were held by the Court "to seriously affect the credit to be given the whole testimony." Touching on Weiss' various contradictions the Court stated: "Mere variation in recollection at different times is not always vital; but when by means of the variations the testimony becomes more favorable to the contentions of the witness with each successive delivery, the Court is required to scrutinize it with some care." As a result of all of the testimony the Court concluded that Weiss did not discover the efficacy of DPG prior to the delivery of Dr. Kratz' paper on Sept. 6, 1919; also that others had disclosed the subject matter of the patent in advance of the patentee and had used DPG several years prior to the time when the patentee claimed to have begun his investigations. A decree was ordered drawn in accordance with the Court's opinion.

Charge for Car Rental in Addition to Transportation Charge Declared Illegal

In the case of Andrews Steel Co. vs. Davis, Court of Appeals, Kentucky, it was brought out that the Andrews Co. and the Newport Co. were located about a mile apart in the yard limits of a railroad and were accustomed to shipping freight to each other. Until 1917 the charge, designated "switching charge" under the tariff schedule, was $2 a car. Thereafter the tariff was changed to read "$2 per car switching, $3 per car rental, $5 total." The Court held that the carrier might not make a separate or additional charge for a necessary element of the transportation service and that the car rental charge was illegal.

Alloy Patent Adjudicated

In the suit of Haynes Stellite Co. vs. Chesterfield in the U. S. District Court of Michigan the plaintiff charged infringement of patent No. 1,057,423 relating to ternary alloys of cobalt, chromium and tungsten. The defendants not only used carbon, but also nickel in their alloy. The Court held that the use of nickel alone and apart from carbon avoided infringement, and that the addition of carbon and nickel, neither of them specified in the patent in suit, also avoided infringement. Claims 1, 2, 3 and 4 were held invalid and claims 5, 6, 7 and 8 valid but not infringed.

Rights of Preferred Stockholders in Distribution of Corporate Assets

The Eddy Paper Co., in order to avoid a receivership, sold its entire assets to another corporation which assumed and paid all the debts of the Eddy Co. and gave it a number of shares of capital stock. The preferred stockholders of the Eddy Co. sought a distribution of the assets in proportion to their holdings. The common stockholders claimed the right to share in the distribution. The preferred stockholders relied on the statute which provided that if the corporation should cease business the remainder of its assets, after paying liabilities and debts, should be applied first in full payment of preferred stock and unpaid dividends then due thereon, and the balance divided pro-rata among the common stockholders. The latter argued that the holders of preferred stock were entitled to only such preference as was granted then in the articles of incorporation, which were silent as to how capital assets were to be distributed in case of insolvency. The Supreme Court of Michigan held that the preferred stockholders were entitled to payment in full before the common stockholders could participate. The articles of incorporation being silent as to a division of the assets, the distribution must be made according to the statute.

On the Engineer's Book Shelf

Chemistry of Wheat Flour

THE CHEMISTRY OF WHEAT FLOUR. By *C. H. Bailey*, professor of agricultural biochemistry, University of Minnesota. Chemical Catalog Company, Inc., New York. Price $4.

Reviewed by F. L. Dunlap

"The data of cereal chemistry are widely scattered. They appear in thousands of published papers, not only in bulletins of agricultural experiment stations and government bureaus, but in numerous American and foreign scientific journals. . . . This monograph represents an attempt to present them in a condensed and systematic arrangement for the convenience of the other workers in this field. . . . The general treatment accorded the subject is essentially similar to that which would be involved in discussing the properties of any like food material. Properties of flour must be considered in their relation to: first, the raw material from which it is manufactured, or wheat; second, the process of manufacture, or milling; third, its adaptability to the principal use to which flour is put, or baking."

The above quotation from the introduction of Dr. Bailey's book, indicates broadly its scope. The contents is divided into 11 chapters as follows: Historical; Wheat in its Relation to Flour Composition; The Growth and Development of the Wheat Plant and Kernel; Influence of Environment on the Composition of Wheat; Defects of, and Impurities in, Commercial Wheat; Storage and Handling of Wheat; Chemistry of Roller Milling; Changes in Flour Incidental to Aging; The Color of Flour and Flour Bleaching; Flour Strength and Enzyme Phenomena; Flour Strength as Determined by the Proteins of Flour and Colloidal Behavior of Dough.

Dr. Bailey has made a notable contribution to cereal chemistry. The labor involved in preparing this work can only be appreciated fully by those who are directly interested in this field, where the mass of literature is well nigh overwhelming. The author has digested this literature in a most scholarly way and skillfully connected the essentials, to make a most readable book. Few of those to whom this work will make its greatest appeal are so situated as to have ready access to adequate library facilities. To them, Dr. Bailey's work will be invaluable, for it summarizes the literature, and in addition, the author has commented on the work of others, and thus indicated what are fertile fields for further development and research.

This book should by all means be in the hands of every one who is at all interested in the chemistry of wheat flour. It not only is a splendid reference book to the most valuable of the literature of this subject, but of quite equal importance are the author's comments. There is no one in the United States whose opinions carry more weight, on this whole subject, than those of Dr. Bailey. The book is splendidly indexed, with both a subject and author index. The bibliography is all collected at the back of the book, references at the bottom of each page being omitted. There may be those who prefer the more common method of citing references, but this is not a vital matter. The work is printed and bound in keeping with the excellent standard of other books of the American Chemical Society's Series of Scientific and Technologic Monographs.

Manual for the Wood Distiller

THE TECHNOLOGY OF WOOD DISTILLATION. By *M. Klar*, translated by *Alexander Rule*. D. Van Nostrand Company, New York. 496 pp. Price $6.50.

This book, which is a translation of the author's second edition reprinted in 1920, is in scope, broad enough to be called a manual of the industry. The history of the industry, kind and sources of raw material, preparation of raw material, production of primary distillates, and the refining of end products are included. An excellent feature of the book is the inclusion of important analytical methods, together with standard specifications for the principal wood chemicals. Although written primarily with Continental and British practice in view, the special features of the American industry have not been neglected.

Case Material From Business Practice

HARVARD BUSINESS REPORTS (VOL. 1). Compiled by and published for the *Graduate School of Business Administration, George F. Baker Foundation, Harvard University*. A. W. Shaw Company, Chicago. 561 pp. Price $7.50.

Reviewing the quarter century just past, we can say that it was notable for advances in mass production—the rapid and yet efficient transformation of raw materials into articles of commerce, made possible through the application of science to industry. Efficiency in production will continue to increase, but it is safe to say that the keynote of the next quarter century will be a similar organization of the business functions—marketing, accounting and finance.

University schools of business already have laid the foundation for such advance, and the present book is the first of a series (perpetual it is hoped) on business practice, as exemplified by case material. It is a recognition of the fact that proper background for the business executive is lacking, and that a large part of his work is concerned with duplicating the creative thought of others. Naturally no quantity of case material, however extensive, can hope ever to supplant the prime executive requisite—judgment—but a study of the 149 problems outlined in this first volume should convince anyone of their worth as an aid to making decisions.

Proper balance has been established at the outset by making the cases representative; that is, cost accounting credit, purchasing, stores-keeping, compensation, budgetary control and financing are but a few of the functions so discussed. As a supplement to basic books on economics and business, "Harvard Business Reports" should be in the executive's library and within easy reach.

Regularization of Employment

THE REGULARIZATION OF EMPLOYMENT. By *H. Feldman*, assistant professor, industrial relations, Dartmouth College. Harper & Brothers, Publishers, New York. 437 pp. Price $3.50.

Since the war, much has been said about waste in distribution and marketing, and implying that the production function is highly efficient. It is true that engineering science has vastly increased the efficiency of raw materials utilization and has given us mass production through machines; but money spent for labor still yields a comparatively poor return, and the position of labor itself is none too enviable. Dr. Feldman's book shows clearly that a great part of waste in production is the result of irregular employment of labor.

To get to the immediate causes, fluctuation in orders and seasonal demand are the big factors in operating variations. And yet, by control through research, diversifying the output, better sales planning, and more intelligent production planning, almost unbelievable results have been obtained in maintaining a uniform output, and hence, of payroll. The possibilities of more generally utilizing the many sound plans for regularizing employment are so great, that Dr. Feldman deserves unusual credit for bringing them collectively to the attention of industry.

Facts About the Workman

MAINSPRINGS OF MEN. By *Whiting Williams*. Charles Scribner's Sons, New York. 313 pp. Price $2.

Whiting Williams' book, "Mainsprings of Men," gives an intimate picture of the workman at work, at play, at home and when idle—not from the viewpoint of an outsider, but written from the heart—the experiences of a wage earner.

Unquestionably the most serious obstacle in the solution of any labor "crisis" has been a mutual lack of understanding, and without an insight into the forces actuating the working man and the manager, there is little or no chance of industrial peace between the two. The mere fact that a foreman, superintendent, or factory owner has risen from the ranks of manual labor does not necessarily assure success in human relations, as the important thing is an *appreciation* of "what the worker wants," "what all of us want," and of means to attain such wants.

The book is replete with illustrative examples that come from many industries, countries and conditions of men. It is, in effect, a manual of personnel management; but such a title would hardly befit the author's dramatic method of presentation.

Principles of Business Organization

FUNDAMENTALS OF BUSINESS ORGANIZATION. By *Webster Robinson*, lecturer in business administration, University of California. McGraw-Hill Book Company, Inc., New York. 230 pp. Price $2.50.

The technical phases of production have advanced to such a state of perfection that wide knowledge of materials, methods and machinery has become available to all, and consequently the manager who strays appreciably from "the one best way" of combining these factors will fall a victim of competition. However, the organization of the human factor has lagged woefully behind the others. Just now the anthracite coal industry is an example of inefficient organization of the human factor, much to the distress of all parties concerned: the operators, the workers and the consumers.

Of course it can be argued that the worker is an intractable element, and not subject to definite principles of management. However, groups of men react with surprising uniformity *under similar conditions*, and hence these reactions and conditions are susceptible to systematic analysis. Robinson's book develops the fundamentals of business organization in a logical manner, and with due regard to the modern practice of mass production. These fundamentals as outlined by the author are (1) definition of policy, (2) functionalization, (3) job analysis, (4) direction, (5) supervision, (6) control, (7) proper delegation of authority, and (8) providing an incentive.

The student of business or of engineering who masters thoroughly the foregoing fundamentals will most surely have gained an immense advantage at the outset of his business experience, and it is likely that many comparatively mature executives would profit similarly from a study of this excellent book.

BOTHERING BUSINESS. By *H. A. Toulmin, Jr.*, B. C. Forbes Publishing Company, Inc., New York. 57 pp.

A discussion of the functions, methods and results of the Federal Trade Commission. The author feels that the Commission, in its present form, is doing great harm to business through the unjust exposure of defendants, and through interference with other departmental functions and courts of law.

BIBLIOGRAPHY OF BIBLIOGRAPHIES ON CHEMISTRY AND CHEMICAL TECHNOLOGY. 1900-1924. By *Clarence J. West*, associate editor, International Critical Tables, and *D. D. Berolzheimer*, consulting bibliographer. Bulletin of the National Research Council, Vol. 9, part 3, No. 50. 308 pp. Price $2.50.

The scientific literature attained such proportions during the period from 1900, that the work of the bibliographer has assumed great importance, as inspection of the present book will testify. Here, in a handy volume alphabetically arranged, is an invaluable working tool for the chemist and chemical engineer. It is surprisingly complete and is certain to prove useful to the profession.

Chemistry in Modern Life

CHEMISTRY IN MODERN LIFE. By *Svante August Arrhenius*, director of the Nobel Institute; translated from the the Swedish and revised by *Clifford Shattuck Leonard*, national research fellow, department of pharmacology, Yale University. D. Van Nostrand Company, New York. 286 pp. Price $3.

"Chemistry in Modern Life" is quite different from the several other excellent books that purport to translate the activities of science in industry into terms of everyday English. The book, although possessed of the necessary unity, is in reality a collection of essays, which in depth of writing and thought are comparable to some of Huxley's popular writings in physics.

No attempt has been made to describe, one by one the rôle of chemistry in individual industries; in fact metals, fuels, synthetic organic chemicals, cellulose and rubber are the only products that receive extended attention. However, these chapters are but illustrative of the principles of chemical science; and indeed most of the book is concerned with fundamentals, such as alchemical theory, modern concepts of physical chemistry, problems of food supply and conservation of the world's natural resources. Credit is due the translator for making available to English-speaking peoples such an inspiring work.

Reducing Friction Losses by Lubrication

POWER PLANT LUBRICATION. By *William Farrand Osborne.* McGraw-Hill Book Co., Inc., New York. 275 pp. Price $3.

Reviewed by G. L. Montgomery

One of the earliest means adopted for improving the performance of kinematic elements was the use of lubricants. Certainly the early Egyptians greased the axles of their chariots and it is extremely probable that the skidways upon which the massive stones of the pyramids and other monuments were moved into place were well lubricated.

Having such a relatively long history, it is the more remarkable that so little has been accomplished toward the development of a dependable science of lubrication. True, there are many who call themselves lubrication engineers and with right, for lubrication is an art and engineering is said to be the practice of an art. However, the more successful branches of engineering have become the application of science rather than of empirical knowledge and it will be a big step forward when lubrication also makes this advance.

One step toward this much to be desired end is embodied in Mr. Osborne's work. He has written a book which sets forth present knowledge on the nature of lubricants, their application to certain classes of machinery and the methods of testing that may be used. This book is one that can be readily understood and used by engineers and well fulfills the author's desire to produce a text that presents in practical form the knowledge now available on the subject. As a result, much of the mystery which seems to surround this subject, as far as the average engineer is concerned, should be dispelled and the type of thinking increased that must come throughout the profession before a demand sufficiently strong to bear fruit in establishing lubrication as a science, exists.

Although this book deals primarily with the lubrication of steam engines, turbines, reduction gears, air compressors, refrigeration machines and internal combustion engines, the facts set forth will also prove useful to those charged with the care of other types of moving machinery. As a practical text for the engineer, this book can be recommended as one that brings out in concise and usable form all the available facts about the lubrication of the class of equipment that it covers.

THE MANUFACTURE OF SULPHURIC ACID (Contact Process). By *Frank Douglas Miles*, senior research chemist, H. M. Factory, Gretna. D. Van Nostrand Company, New York. 427 pp. Price $12.

This book, which is the fourth volume in the series "The Manufacture of Acids and Alkalis," originally prepared by Lunge, and rewritten under the direction of Cumming, the technical and scientific aspects of the various contact processes are discussed.

The scope of the book is extremely broad, including historical development, the physical chemistry of contact reactions, preparation of contact masses, purification of gases, absorption of sulphur trioxide, and detailed remarks on the Grillo, Tentelew and Mannheim processes, in their industrial aspects. The wealth of data on plant design and operation virtually removes the veil of secrecy that prior to the War at least, so long surrounded commercial manufacture by the contact reaction. It is a remarkable piece of work, and does honor to the series.

BLACKS AND PITCHES. By *H. M. Langton*, director, Messrs. J. E. Walker & Co., Ltd., Hull. D. Van Nostrand Company, New York. 179 pp. Price $4.50.

This book, one of the "Oil & Colour Chemistry Monographs," is truly a condensed reference work on the black pigments and pitches. Production methods, properties and uses of various blacks, such as carbon black, lampblack, and the fixed carbon blacks are described thoroughly and yet concisely. Industrial applications of blacks, such as in paints, inks, rubber stocks; and applications of pitches and bitumens in fabrics and paints, are treated in detail.

THE CHEMICAL ACTION OF ULTRAVIOLET RAYS. By *Carleton Ellis* and *Alfred A. Wells*, assisted by *Norris Boehmer*. The Chemical Catalog Company, Inc., New York, 362 pp. Price $5.

Scientific, technical and popular interest in the subject of ultraviolet radiation is such that a book written by the authors of numerous articles in this field is particularly welcome and timely. The book, which begins with a description of the physical apparatus for producing the rays, is a veritable handbook for the research worker in applied chemistry, biology or therapy. The inclusion of essentially all pertinent references to the technical literature of ultraviolet radiation makes the book of great additional value.

THE CHEMISTRY OF DRUGS. By *Norman Evers*, chief chemist to Messrs. Allen and Hanburys, Ltd. D. Van Nostrand Company, New York. 247 pp. Price $9.

A reference text of the chemical constitution and reactions of synthetic and natural drugs. The book is written distinctly from the standpoint of pure chemistry, rather than from that of manufacturing technique. Valuable appendices on the chemical constitution and physiological action, and on lists of various types of drugs, have been included.

VOLUMETRIC IODATE METHODS. By *George S. Jamieson*, chemist, Bureau of Chemistry, U. S. Department of Agriculture. The Chemical Catalog Company, Inc., New York. 96 pp. Price $5.

This is a complete manual of the volumetric iodate methods that have been developed during the past 20 years. A few of the procedures included are the determination of antimony, arsenic, copper, mercury, molybdenum, tin, zinc, hydrazine, hydrogen peroxide, sodium thiosulphate, sulphurous acid and sulphites. An excellent bibliography completes the book, which should do much to widen the use of this extremely accurate quantitative method.

THE CHEMICAL COLORING OF METALS. By *Samuel Field* and *Samuel R. Bonney* of the Polytechnic Institute of Northampton. D. Van Nostrand Company, New York. 259 pp. Price $4.

Metal coloring is an art long identified with a select group of craftsmen. Although proficiency in such an art is largely the result of rule-of-thumb practice, a compilation of accepted methods should be helpful to workers everywhere.

Most of the book is descriptive of coloring methods for copper, brass, gold, silver, aluminum, iron, tin and nickel. There is brief mention of lacquering, electrodeposition, and of the elementary chemistry underlying the metal arts. It is evident that the book is intended for experienced workers, as the text is somewhat superficial for successful amateur endeavor.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Aspects of Chemical Power Supply from an Engineering Standpoint Discussed by Authorities on Electrochemical Industry

On pp. 848-850 of the November, 1925, issue there appeared an article entitled "Electric Power Supply of the Future for Chemical Industry," by R. S. McBride. This article has caused considerable comment, the nature of which seems to indicate publication at this time, as interest in hydro-electric power for industrial purposes is at high ebb.

Water Power as Auxiliary to Steam

To the Editor of Chem. and Met.:

Sir—I am in thorough agreement with your position that the average hydro-electric development should be used only for supplying power to industries of high load factor. There are only limited storage facilities on many hydro-electric developments which enable them to effectively use their water for variable loads.

I think, however, that the development of hydro-electric power is progressing along the lines of attempting a better utilization of variable stream flow and that before long instead of speaking of steam auxiliaries, many of the hydro developments will become hydro auxiliaries to uniformly loaded steam plants. Of course, you realize the physical limitation to many hydro developments and that storage of this kind is not always economically possible and I am assuming that it is this last class of exceptions that you are attempting to convert to your ideas. W. S. LANDIS.

American Cyanamid Company,
New York.

Control by Public Utilities Foreseen

To the Editor of Chem. and Met.:

Sir—I have read your article on electric power supply with very much interest and regard it as a valuable diagnosis of current conditions. I am not so certain that I agree with your views as to therapy and treatment. You seem to adumbrate some sort of governmental priorities. This is too intelligent a policy to be a political possibility; and if it were one might be quite certain that in application propaganda and wire-pulling would count for more than the actual broad economic necessities of the case. This of course is just saying that government action in such matters, if taken, might, as usual, do more harm than good. I am sure the electrochemical industries as such don't care whether they operate here or abroad. We are at present witnessing the beginning of an enormous expatriation of the aluminum industry, due to the conditions you outline in your article, i.e., competition of public utilities for water power. Other things will follow as available power and low rates and *in economically favorable localities* get scarcer. The situation is even worse than you stated; in some important localities the tendency is for the public utilities to control the hydro-electric generating companies. Competition under such circumstances is clearly and heavily weighted. The real importance of the matter is that the electrochemical industries are key industries of the first rank and the results of their even partial expatriation, if another war comes, are hardly to be imagined.

ELECTROCHEMICAL.

Electrochemical Load Factor Ideal

To the Editor of Chem. and Met.:

Sir—The demands of electric power for electrochemical purposes are quite different from those of other industries. From the standpoint of the generating companies, they should be considered quite ideal for their demand is for large blocks of power on a 24-hour basis and this makes for a most constant load factor. This differs very decidedly from the electrical demands of other industries and the differences will doubtless present problems for the future. The ideal situation is probably one which is best illustrated by Niagara Falls, where by far the largest amount of power is consumed by electrochemical industries on a 24-hour basis without the complication of a large day-time demand.

American Magnesium Corporation, W. G. HARVEY.
Niagara Falls, N. Y.

Cheapness of Water Power Exaggerated

To the Editor of Chem. and Met.:

Sir—It appears to me that you have approached the subject as a very large part of the non-electrical public does approach it, on the apparent assumption that all the hydro power is like Niagara Falls, which is the seat of such wonderful accomplishment on the part of the electro-chemical industries. If your entire discussion is confined to the disposition and use of the very rare water powers where huge amounts of steady hydro-electric energy can be obtained on relatively moderate investment, there may be some basis for some of the arguments you present. On the other hand, if the argument, as it appears to be, is with reference to general development of all sizable water powers, much of the argument can be somewhat misleading. The example which you use presupposes a hydro-electric plant the original cost of which is well under $300 per hp. On many of the large water power projects now under consideration in the electric light and power industry $400 and even $500 per hp. will be necessary to carry them to completion. On the other hand, steam power plant practice is making constant progress to reach a switchboard cost per kw.-hr. for 100 per cent load factor under the figure you mention. This means that it is quite misleading to leave the impression that there is any such divergence in the general cost of hydro and steam power.

The general assumption that hydro-electric plants are always used for base load plants with steam-electric

stations being used for peak has many exceptions. Sometimes we find exactly the opposite the case. It all depends upon the relative locations and economies of the various plants under consideration, as well as the all important feature of variation of the stream flow.

I point out some of these arguments and considerations which might be termed to be on the other side of or counter to some of your arguments and conclusions in order that there may be editorial and technical discussion on many aspects. The general tendency in the development of power supply is to concentrate it more and more in the hands of the professional and experienced power producers composing the electric light and power industry. From the very nature of matters, large electrochemical users of power will earn the lowest rates and there should be no fear that any condition will arise which will make uneconomical the continued operation of those processes which depend upon continued supply of electrical energy.

Bonbright & Company,
New York City. H. V. BOZELL.

Long Distance Transmission Unsound

To the Editor of Chem. and Met.:

Sir—We users of Niagara power feel strongly, I think without exception, that our industrial situation there is sound. A continuous hydro-electric development can be justified only by a continuous use of its output. Water going over the Niagara River unused a part of the day is wasted energy, and the load factors above 90 per cent are the only justification for developing water powers of that kind.

A water power like the New England Power Company is in a somewhat different situation. A continuous flow of water in its streams does not take place, and a storage has been provided which, you might say, stores kilowatt hours. Such a condition, therefore, is a better one for low load factor use, and the sale of such power to large users for electrochemical purposes may not be justified; but in places where continuous flow exists, there is no argument, it seems to me.

There has been some talk of transmitting hydro-electric power to this part of the country from long distances. The result will never be favorable to the electrochemical industry. Power costs under such conditions are too high for most of us to stand. A nice balance has to be made between the other economic features of location and the cost of electric energy.

Norton Company,
Worcester, Mass. L. E. SAUNDERS.

Should Remove Duty on Electrochemicals

To the Editor of Chem. and Met.:

Sir—From a practical standpoint I personally feel that the solution of the problem in the United States is to allow electric furnace, electrothermic and electrolytic products to enter the United States free from Canada, or at a reasonably low rate of duty, in which case our large amount of electric power could be utilized economically and the power in the United States could then be utilized in the industries where power is not a large item of cost and prices thus obtained which are commensurate with the cost of the power. The extension of industries in the Eastern States where electric power is a large item of cost seems to me to be based on a fallacious economic theory. H. W. MATHESON.

Canadian Electro Products Company, Ltd.,
Montreal, Canada.

Solvents for Lacquers

A review of present requirements and a forecast of the future development of the industry

NO PHASE of the development of pyroxylin lacquers has attracted wider attention in chemical industry than has the production of solvents. Dr. Donald B. Keyes, director of research, U. S. Industrial Alcohol Co., who has recently reviewed this subject on several occasions, points out that most lacquers consist of nitrocellulose, solvent, resin, plasticizer, diluent and pigment. Solvents for lacquer, from the standpoint of chemical constitution, are principally alcohols and esters. The esters dissolve the nitrocellulose while the alcohols and some of the esters dissolve the resins. Ethers, aldehydes and ketones are not commonly employed. From a physical viewpoint solvents are divided into three types: (1) Low boilers such as ethyl alcohol and ethyl acetate, (2) Medium boilers such as butyl alcohol and butyl acetate, and (3) High boilers such as ethyl lactate and butyl propionate.

The function of the low boilers is to form a solution with a resultant low viscosity so as to make application easy; but the low boiler must not have too high a vapor pressure or evaporation will take place too rapidly leaving a weak film. For this reason acetone is unsatisfactory. Medium boilers impart flowing characteristics to the lacquer. The high boilers serve to produce a non-blushing film and give gloss to the final flow.

Considerable emphasis was placed by Dr. Keyes on anhydrous ethyl alcohol and acetate as they are extremely good solvents for lacquer components, there is an abundant source of raw material for their manufacture; dry ethyl alcohol plus dry ethyl acetate is very near a universal solvent for all resins, and finally both solvents can be produced at a low price. Plasticizers also closely related to the lacquer solvents proper impart final flow, non-blushing characteristics, blending of solid components and gloss to the lacquer film. A good plasticizer must be a solvent for nitrocellulose and must mix with the resin. Tri-cresyl-phosphate and diamyl-phthalate are examples of satisfactory plasticizers.

Thorough drying of each coat of lacquer applied to a surface is recommended in order to insure the complete evaporation of those solvents such as the medium boilers which if allowed to remain will finally break down and disrupt the film causing failure. Forced drying is desirable where feasible.

Dr. Keyes predicts that the future of lacquer will be in the field of interior decoration and that coal and petroleum will be the basic raw materials for the production of solvents for lacquer coatings. The lacquer of the future, Dr. Keyes believes, will in all probability be a condensation product formed from two solutions which when mixed just before using will chemically react after application and unite under the influence of a powerful catalyst to form a permanent, protective finish for every surface.

Dr. Keyes has given his talk on solvents for lacquers before the local clubs of the Paint, Oil and Varnish Association in Brooklyn, Philadelphia, Chicago, Louisville, Cincinnati, Detroit and St. Louis as well as to the sections of the American Chemical Society located at New York City, Baltimore, Urbana, Ill., and South Bend, Ind.

Government Publications

Gases in Metals, Part II. The Determination of Oxygen and Hydrogen in Metals by Fusion in Vacuum, by L. Jordon and J. R. Eckman. Bureau of Standards Scientific Paper 514.

Origin of Quenching Cracks, by H. W. Scott. Bureau of Standards Scientific Paper 513.

Fertilizers—Some New Factors in Domestic Fertilizer Production and Trade, by H. A. Curtis. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 372.

The Lead Industry, Part I. North America, South America, and Oceana. Part II. Europe, Asia, and Africa, by R. Santmyers. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 368.

Plastic Magnesia, by O. C. Ralston, R. D. Pike,, and L. H. Duschak. Bureau of Mines Bulletin 236.

Georgia and Alabama Clays as Fillers, by W. M. Weigel. Bureau of Mines Technical Paper 343.

Properties of Typical Crude Oils from the Producing Fields of the Western Hemisphere, by A. J. Kraemer and L. P. Calkin. Bureau of Mines Technical Paper 346.

Analyses of Alabama Coals. Bureau of Mines Technical Paper 347.

Paraffin Wax and Its Properties; Methods of Testing Wax and of Analyzing Oil-Wax Mixtures, by L. D. Wyant and L. G. Marsh. Bureau of Mines Technical Paper 368.

Diatomaceous Earth (With Special Reference to Nevada) by C. W. Davis. Bureau of Mines Serial 2718.

Gas Mask for Protection in Air Against all Gases, Vapors, and Smokes, by A. C. Fieldner, S. H. Katz, H. W. Frevert, and E. G. Meiter. Bureau of Mines Serial 2719.

Sugar-Cane Sirup Manufacture, by H. S. Paine and C. F. Walton. Department of Agriculture Department Bulletin 1370.

Evaporation Losses of Gasoline in the Refinery, by L. Schmidt (In cooperation with the State of Oklahoma). Bureau of Mines Serial 2721.

Bureau of Mines, statistical statements for 1924 for the following minerals: Fluorspar and Cryolite, Magnesium and Its Compounds, Feldspar, Clay, Phosphate Rock, Potash, Arsenic, Platinum and Allied Metals.

Manufacturing statistics. Production reports by Census of Manufactures giving final summaries for the following: The Leather Industries, 1923; Butter, Cheese, and Condensed and Evaporated Milk, 1923; Pulpwood Consumption and Wood Pulp Production, 1924.

The annual reports of the past fiscal year are being issued by the various Government Bureaus. Those already available are: Bureau of Mines, Bureau of Standards, and Bureau of Navigation, all of the Department of Commerce; U. S. Geological Survey, of the Department of the Interior; and Chemical Warfare Service, of the War Department.

Fuels for High-Compression Engines, by Stanwood W. Sparrow. National Advisory Committee for Aeronautics Report No. 232.

Thermal Expansion of Tungsten, by Peter Hidnert and W. T. Sweeney. Bureau of Standards Scientific Paper No. 515.

National Bureau of Standards—Its Functions and Activities, by George K. Burgess. Bureau of Standards Circular No. 1.

Dielectric Constant, Power Factor and Resistivity of Rubber and Gutta-Percha, by H. L. Curtis and A. T. McPherson. Bureau of Standards Technologic Paper 299.

Compressibilities of Gases. Bureau of Standards Miscellaneous Publication No. 71.

Abridged Volume Correction Table for Petroleum Oils. Bureau of Standards Supplement to Circular 154.

Government Master Specifications have been issued by the Bureau of Standards as follows: Asphalt-Saturated Woven Cotton Fabric for Water-Proofing, Circular 287; Textile Materials (Methods of Physical and Chemical Tests) Circular 293; Slate-Surfaced Asphalt Prepared Roofing and Shingles, Circular 285; Paper Towels, Circular 294; Fire Clay, Circular 298; Gas Hose, Circular 290; Rubber Bands, Circular 294.

Chemistry of Deposition of Native Copper from Ascending Solutions, by Roger C. Wells. U. S. Geological Survey Bulletin 778.

Geology of a Part of Western Texas and Southeastern New Mexico with Special Reference to Salt and Potash, by H. W. Hoots. U. S. Geological Survey Bulletin 780-B.

Boiler Water Conditioning with Special Reference to High Operating Pressure and Corrosion, by Dr. R. E. Hall. Bureau of Mines Serial 2727.

The Bureau of Mines Orsat Apparatus for Gas Analysis, by A. C. Fieldner, G. W. Jones and W. F. Holbrook. Bureau of Mines Technical Paper 320.

The Legendary "White Metal" and Its "Ore," by C. W. Davis. Bureau of Mines Circular 6000.

Value of Bituminous Coal and Coke for Generating Steam in a Low-Pressure Cast-Iron Boiler, by C. E. Augustine, James Neil and William M. Myler, Jr. Bureau of Mines Technical Paper 367.

The Disposal of Petroleum Foots Oil, by L. G. Marsh and L. D. Wyant. Bureau of Mines Serial 2724.

Recent Articles In The Technical Literature

Calcium Sulphite. The precipitation of calcium sulphite with reference to the sugar industry. R. G. Farnell, *Trans. Soc. Chem. Ind.*, vol. 44, No. 48, p. 530 T.

Dye Plant. Description of a modern British dye plant. Anon., *Chem. & Ind.*, vol. 44, No. 51, p. 1218.

Heavy Chemical Industry. Discussion of the heavy chemical industry in 1925. R. Furness, *Chem. & Ind.*, vol. 44, No. 52, p. 1241.

Furnace Design. Present status of furnace and retort design and the synthetic ammonia, beet sugar, silk, cement, and paper industries. S. G. Ure, *Chem. & Ind.*, vol. 44, No. 52, p. 1244.

Carbonization. Research with a continuous vertical retort. R. E. Thwaites and J. Packer, *Trans. Soc. Chem. Ind.*, vol. 44, No. 47, p. 519 T.

Low - Temperature Carbonization. General discussion of economic and technical considerations. H. W. Brooks, *Combustion*, vol. 14, No. 1, p. 46.

Rubber Industry. General review of studies on rubber and the rubber industry. Bibliography included. Jean-Ch. Bougrand, *Chim. & ind.*, vol. 14, No. 6, p. 823.

Plant Safety. Discussion of safety measures in the manufacture of nitric, sulphuric, and mixed acids and nitrate of ammonia as used in the manufacture of explosives. S. H. Kershaw. *Ind. & Eng. Chem.*, vol. 18, No. 1, p. 4.

Tar Distillation. Heat economy and improved operation in tar distillation. Alfred Ott, *Apparatebau*, vol. 37, No. 20, p. 255.

Stainless Steel Equipment. Use of a high chromium steel in the construction of chemical apparatus. B. Strauss, *Apparatebau*, vol. 37, No. 24, p. 309.

Rust Prevention. Discussion of various methods of rust prevention. J. Swoboda, *Chem. Zeit.*, vol. 49, No. 139, p. 977.

Progress in Petroleum. Progress in the petroleum industry in the year 1924. R. Kissling, *Chem. Umschau*, vol. 32, No. 45, p. 286.

Electric Furnace. Description of the Nathusius electric furnace. E. Blau, *Chem. Zeit.*, vol. 50, No. 1, p. 6.

Measuring Dust in Air. Method for measurement of dust in air or industrial gases. W. Allner, *Zeit. angew, Chem.*, vol. 38, No. 51, p. 1170.

Ammonia Oxidation. Investigation of processes for catalytic ammonia oxidation under plant conditions. W. J. Maliarewski and N. A. Maliarewskaja, *Zeit. angew. Chem.*, vol. 38, No. 49, p. 1113.

Chamber Process. Discussion of chemistry of the lead chamber process. F. Raschig., *Zeit. angew. Chem.*, vol. 38, No. 45, p. 100.

Bakelite Equipment. Use of bakelite in chemical apparatus. H. Lebach. *Zeit. angew. Chem.*, vol. 38, No. 48, p. 1091.

Miscellaneous Publications

Among the publications issued recently by sources outside the government are the following:

Factors Affecting Production of Lump Coal, by J. E. Tiffany, et al. Issued as Bulletin No. 19 of the Carnegie Institute of Technology, giving results of co-operative study by that Institute and the U. S. Bureau of Mines.

Ball Mill Crushing in Closed Circuit with Screens, by E. W. Davis. Bulletin No. 10 of the University of Minnesota.

Physical and Chemical Survey of the National Coal Resources No. 5. The Lancashire Coalfield. The Smith Seam. A British Fuel Research Board publication issued by the Department of Scientific and Industrial Research.

Report of the Fuel Research Board for the period ended Dec. 31, 1924, with Report of the Director of Fuel Research. This report is also issued by the British Department of Scientific and Industrial Research.

The Plant Notebook

An Exchange for Operating Men

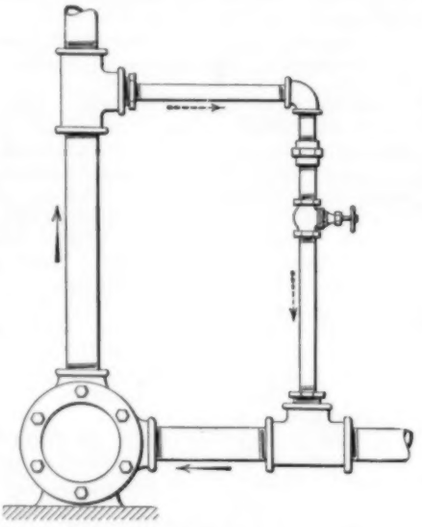
Substituting a Globe Valve for a Regulating Valve

By E. Y. Wolford
University of Pittsburgh, Pittsburgh, Pa.

In rotary pump installations it is customary to provide a bypass around the pump to protect it in case of stoppage of the discharge line which might damage the driving mechanism as well as the pump. In order to prevent the pump from simply churning the liquid being pumped around the by-pass circuit, a regulating valve is located in the by-pass. The regulating valve is provided with a spring which may be adjusted so that the valve will open at any desired pressure, say 25 lb., and allow the pump to circulate the liquid through the bypass, thus preventing the accumulation of a dangerous pressure. It is probably not generally realized, that this regulating valve can be satisfactorily replaced by a common cheap standard globe valve.

On installing a new pump recently, we found that the regulating valve previously used could not be made to work. A new one could not be obtained for several days, but there was an urgent need for immediate operation of the equipment, a 2 x 2 foot-16 plate filter press, filtering about 0.1 per cent of finely divided solid from a fairly mobile liquid, operating at about 25 pounds pressure and discharging three to six gallons per minute. We installed a globe valve in the bypass as shown in the accompanying diagram. The intake line and discharge line to the filter press were 1½ in. and the bypass was ¾ in. pipe. On starting the pump, the globe valve was turned wide open and no filtered liquid was discharged from the press. The globe valve was gradually closed until the usual flow was discharged from the press. The discharge was found to be very sensitive to regulation of the globe valve and any desired flow could be gotten with much less regulating difficulty than with the customary regulating valve. When a satisfactory flow was maintained, the globe valve regulation was set by tightening the packing nut down on the stem so that it would not jar open or shut.

This globe valve has been in constant service for nearly a year and has proven satisfactory, so a regulating valve has not been purchased. However it is to be regarded as a somewhat make-shift device, for when discharge stoppage occurs, pressure does build up, although not to a dangerous extent. Therefore, we instruct the filter press operator that when he notices a suddenly reduced discharge indicating stoppage, he is to open the bypass valve immediately and investigate later. We notice that this can be done long before a dangerous pressure accumulates.



Method of Installing Globe Valve in Pump Bypass

Such a valve has been found to be a satisfactory substitute for the regulating valve usually employed

While rotary pumps will generally develop good suction they lose this ability with long use through wear, so that the pump is set below the level of the intake source, to keep it primed. Hence, as shown in the diagram, the union in the bypass is placed above the globe valve, so that if it becomes necessary to take down the line from the pump to the press, the pump will keep the main line closed and the globe valve will shut off the bypass. Of course in good installations a valve is located on the main line where it is connected to the tank containing the liquid to be pumped. However should this valve fail to work, the arrangement shown will provide a convenient additional safe-guard.

The writer wishes to acknowledge the collaboration of Mr. J. F. Fitzpatrick in making this installation.

Reserve Supply of Power Assured

One method of safeguarding against loss due to the temporary shutdown of the source of power supply upon which a plant may depend is that adopted by the Grasselli Chemical Co. in their Hamilton, Ontario plant. This plant has installed a 200 hp., Type "T," Foos gas engine, direct-connected to a generator. This is held in reserve and, in cases of emergency, will supply sufficient power to operate those services in the plant that must be continuous if losses are to be avoided.

Welded and Riveted Repairs Compared

A pertinent comparison between electrically welded and riveted repairs in plant maintenance is given by the Lincoln Electric Co., of Cleveland, Ohio, in a report on arc welding. Two 4x4-in. patches were put on a dust chute in a cement mill by the two methods with the following costs:

Riveted Patch Two men, two hours		Welded Patch One man, five minutes	
Drill holes	$1.20	Welding	$0.08
Fit up	.60		
Rivet patch	.60		
Total cost	$2.40	Total cost	$0.08

An incidental, but not unimportant, economy of electric welding is that in many cases the apparatus or machine under repair does not have to shut down while the repair is being made.

Obtaining Superheated Steam With Electric Heat

The Vegetable Oil Co., West Berkeley, Calif., is using two electric steam superheaters in order to supply suitable steam for one of its processes, dry steam at a temperature of 650 deg. F. being needed. The steam available has a temperature of 300 deg. F.

The superheater, of home-made design, has two banks of steam pipes, U-shaped, with 16 General Electric air heaters within the U's, the total connected load being 60.2 kw. Dry steam enters at 300 deg. F., the temperature corresponding to the pressure, and is superheated to 650 deg. F., or a superheat of 350 deg. F., the capacity being approximately 500 lb. per hour.

The superheater is enclosed in a furnace, unventilated, with sheet metal lining inside and outside, and nine inches of insulating brick between. There are no doors or openings. Control is entirely by hand, there being four electric circuits independently controlled, and an indicating thermometer shows the steam superheat. The control is so arranged that a pilot light lights up whenever units are energized, thus acting as a safeguard against leaving units with power on unattended with the possible result of burning out units from overheating.

Electricity was chosen for superheating in preference to a combustion method because of the improved fire and insurance risks which resulted. It was necessary to superheat the steam at a point near the center of the factory for vegetable oil chemical processes, and live steam was not available. One superheater has been in use for a number of months and a second has just recently been built.

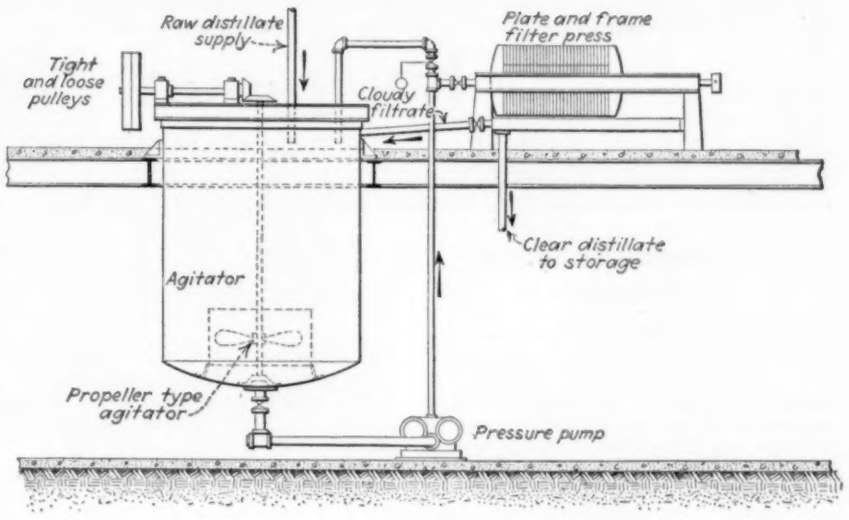
Uninterrupted Filtration of Light Distillates

The accompanying line drawing shows an apparatus layout that has given good results in several plants in the filtration of light distillates. The drawing shows a closed tank equipped with a propeller type agitator driven by a vertical shaft that may be suspended instead of operating in a step bearing, as shown. This agitator is surrounded by a shallow cylindrical sleeve, which, being open at the top and bottom, insures effective circulation. If gasoline is being treated, obvious precautions in the design of the agitator will be taken to avoid sparks from moving parts. The only other essential part of the layout is a pressure filter, a plate and frame press being shown in the sketch to the right of the agitator tank.

The gasoline or other distillate is charged into the tank with a predetermined proportion of filter aid. When a correct level in the tank is reached, a pressure pump is started, the mixture pumped to the filter and filtration commenced. The initial filtrate, usually cloudy, is returned to the agitator. If a proper filter aid is used, with a sufficiently low specific gravity, it will have no tendency to settle in the lower parts of the press; but will form a cake of even thickness from the commencement of pumping, through which all distillate subsequently added to the agitator must pass.

Concurrently with the starting of the pump, a flow of distillate and filter aid is maintained into the agitator tank. The pipe line connecting the agitator tank and the filter through the pump is provided with a safety valve and bypass back to the agitator tank, so that release is secured as the pressure rises. If two presses are used, uninterrupted filtration can be secured, one press being discharged and cleaned while the other is taking the flow of distillate from the pump.

Acknowledgment is made to the Filtrol Co., Los Angeles, Calif., for the information and sketch embodied in this article. The layout was made for use with the filter aid made by that company.



Layout for the Filtration of Light Distillates
If a second filter press is installed, this layout will permit continuous filtration to be carried on

How Roller Bearings Cut Conveyor Costs

By V. D. Green
Cleveland, Ohio

The advantages of roller-bearings in motor and countershaft drives are becoming thoroughly recognized. Their use in conveyors, bucket elevators, etc., has not however received so much attention. Nevertheless the economy, especially on long conveyors, may be considerable; as the Peerless Portland Cement Co. discovered recently at the installation of material-handling equipment at their new $3,000,000 plant at Detroit, Michigan.

This conveyor installation, which was designed and manufactured by The Stearns Conveyor Co., Cleveland, Ohio, was for the purpose of handling coal and limestone from the unloading points—the railroad tracks and the dock—to the respective storage piles. It consists of four conveyors, averaging 400 ft. in length each. It was decided on the advice of the conveyor-makers, to install Timken roller-bearing troughing idler pulleys and return rollers instead of the plain bearings that have been generally used in conveyor pulleys in the past.

It was found that, notwithstanding the somewhat higher cost of this type, the result was more economical in overall cost and operating and maintenance expense than would have been the case had plain bearings been used. On one conveyor, for instance, 590 ft. long by 54 in. in width the saving in the driving power alone amounted to 35 per cent. This was not all, however, for in view of the reduced horsepower transmitted, and the consequent lessened strain on the belt, it was perfectly satisfactory to use an 8-ply belt instead of the 12-ply belt which would have been required had plain bearings been used.

The reason for these unusual economies as compared with that obtained in motor-bearings, etc., is that although the difference between the two types of bearings is only about 1.2 per cent for each individual pulley, yet the large number employed in the average conveyor line produces a cumulative effect.

Extraction Turbine Gives Low Cost Current

A turbine generator of the extraction type is used by the Northern Paper Mills, Green Bay, Wis., for generating some electricity needed in the plant and also for furnishing low pressure, extracted steam for process work and heating. This equipment, installed three years ago, is a General Electric, 2,000-kilowatt, 3,600-r.p.m. machine, the generator being rated 2,500 kva., 480 volts, 60 cycles, 3-phase at .80 power factor.

When the turbine is operating straight condensing the cost per kilowatt-hour is $.0077 and, when 7,500 pounds of steam per hour are being extracted, the cost is $.0062. The total saving per year over the old method, based on a recent analysis made at the Northern Paper Mills, is approximately $40,000. Over a possible installation of a straight condensing type turbine, to carry the electrical load handled by the present unit and the use of live steam for heating and bleaching, $11,467 is saved annually.

Based on this, it is estimated the turbine installation has saved the Northern Paper Mills, over the current price of purchased power, better than $100,000 since installation and the total saving due directly to the installation of the generating equipment has exceeded the original cost of the installation, including all foundations, buildings, piping, equipment and the changing of approximately 250 motors from 25 cycles to 60 cycles at the time of the installation of the power unit and other incidental costs.

Method for Weighing Samples Quickly

When a large number of routine tests are made daily, as in the estimation of butter fat in cream, which usually arrives at the plant in comparatively small containers, a saving in time spent in weighing the samples may be achieved by the adoption of the following method:

An empty test bottle is placed on each pan of the balance. These bottles are seldom or never of the same weight, and a rider weight is moved to one side or to the other until the pans are in equilibrium. A weight, corresponding to the amount of cream to be taken for the test, is then placed, alongside the empty test bottle, in one pan. The cream is then added by pipette to the test bottle on the other pan. When the pans are again in equilibrium, the weight is removed, and cream added to the empty test bottle until the weights of cream in both bottles are the same. By this simple method one small adjustment for bottle weight suffices for two weighings.

Equipment News

From Maker and User

Corrosion Resisting Material

By Carlton M. Dean

Department Superintendent, Merrimac Chemical Co., Woburn, Mass.

The exceptional corrosion resisting properties of the alloy valves made by the Pioneer Alloy Products Co., Cleveland, Ohio, should be of interest to those chemical operating men who are not acquainted with the material. Several of these valves of various sizes have been in use for two years at the plants of the Merrimac Chemical Co. under many severe conditions—conditions which up to the time of the introduction of this material had proved troublesome.

The valves have been particularly successful in handling sulphuric acid at temperatures up to 250 deg. F. and in all concentrations from 93 to 101 per cent available. Valves and cocks of many other materials and styles had previously been tried with very poor results. They all either corroded in a short time so as to leak or else to stick badly unless in constant use. Especially in cases where any sediment was present in the liquid handled was trouble encountered. No lubricant was found which would prevent the lubricated valves from sticking in the presence of hot, concentrated acid. The Pioneer alloy valves, on the other hand, have never had the slightest repair or even repacking in this service and always open and close freely whether used frequently or not.

Pioneer alloy is also in successful use in mixed acid of various concentrations and temperatures both as valves and as centrifugal pump impellers and shafts. In many cases where steel shafts have been badly corroded at the point where they pass through stuffing boxes they have been replaced by Pioneer alloy with the elimination of all repairs and leakage.

Other uses for the alloy, where troublesome conditions formerly existed, include hot caustic liquors, both concentrated and dilute, nitration mixtures in organic processes and acetic acid. The only place where corrosion was ever found was in the case of warm bisulphite of soda solutions saturated with sulphur dioxide.

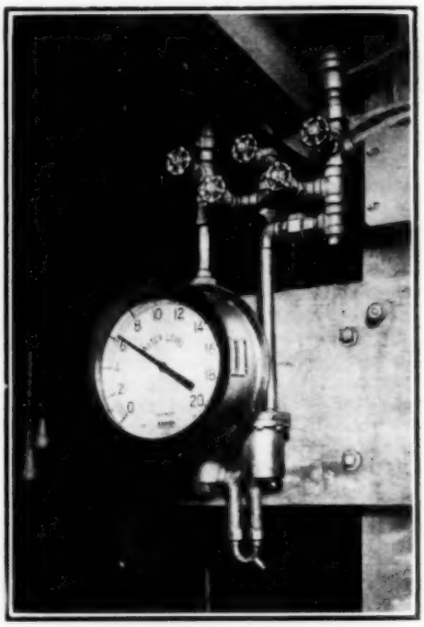
The first cost of this alloy is high, but when freedom from repairs and operating delays is considered it appears from experience to date that a real saving is the net result of its use. It represents an important advance in the development of corrosion resisting materials for use in the chemical industry.

Compressors

The Norwalk Co., South Norwalk, Conn., has recently developed two new types of compressors for use in chemical plants, as shown herewith.

The compressor in Fig. 1, Type TB-HB, is for such purposes as compressing a mixture of hydrogen and nitrogen from 4,100 lb. per sq.in. pressure to 4,500 lb., in a nitrogen fixation plant. The gas end consists primarily of a steel forging rigidity attached to the running gear, which is of the enclosed, splash lubricated type. The piston rod stuffing box between the gas cylinder and the running gear is water-jacketed, and the entire piston assembly is provided with an outboard or end support requiring another stuffing box which is also water-jacketed. Ring plate valves are used.

Fig. 2 shows a new 3-stage compressor primarily for acetylene, but also for air and other gases. This machine compresses up to 2,000 lb. per sq.in. This machine has a double acting intake, the first stage cylinder being located midway between the second and third stage cylinders. The second stage cylinder lies between the first stage and the running gear. It is single acting and compresses toward the running gear. The third stage cylinder is on the opposite end of the first stage and is also single acting, but compresses away from the running gear. Open tank intercoolers are used which are accessible and in which any leakage can be immediately detected. Ring plate valves are used.

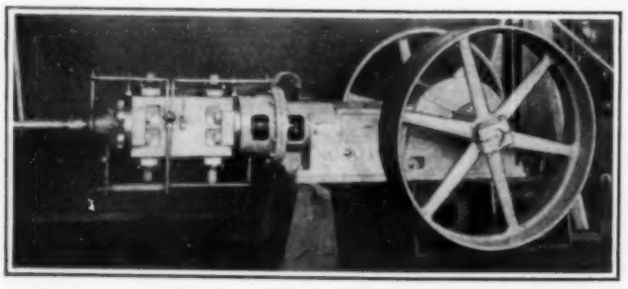


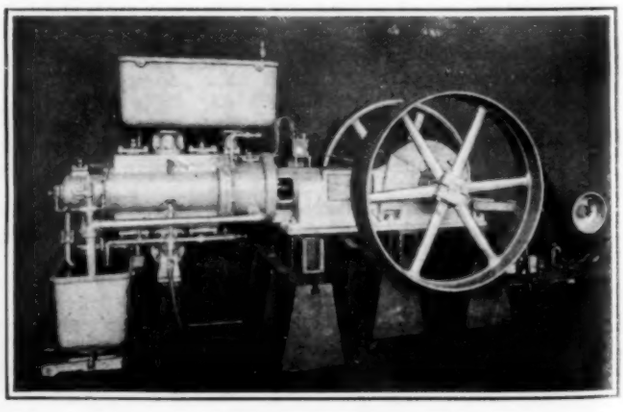
Indicating Boiler Level Gage

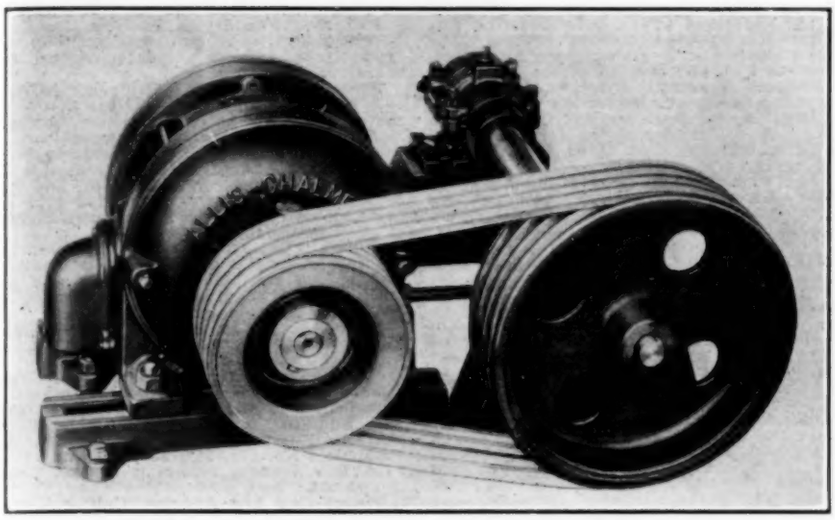
Boiler Level Gage

A recording or indicating boiler level gage has been developed by The Foxboro Co., Foxboro, Mass. The indicating instrument is shown in the photograph herewith. The instruments are operated by differences in head between maximum high water and any other point. The principle is that of the mercury float type differential mechanism, in which the difference of pressure on the two legs of a U-tube causes a change in the relative heights of the mercury columns and actuates a pen arm through the rise and fall of a float.

Fig. 1—Below—Booster Compress for Hydrogen-Nitrogen Mixtures up to 4,500 Lb. per Sq.In.
Fig. 2—At Right—Three Stage Acetylene Compressor, Compressing up to 2,000 Lb. per Sq.In.







Short Center Drive of New Type
This drive is said to avoid the slip, back lash, lost motion and other troubles of some short center drives

Close Center Drive

A development in the field of power transmission machinery has just been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis., which has recently perfected a new type of short center, flexible drive, known as the "Texrope." This drive consists of two grooved sheaves and a number of specially constructed endless "V" belts. The sheaves are set just far enough apart so that the belts fit the grooves without either tension or slack.

Previously no short center drive is said to have existed that did not have slip, back lash or lost motion, which caused jerky starting and uneven running. Since the "Texrope" belts just fit the sheaves, it is claimed that there is no slack or lost motion in the drive. Because of the "V" construction, they are said not to slip, as the harder the pull the more firmly the belts grip the grooves. Being elastic and stretchable, it is claimed that they do not jerk, either in starting, acceleration or running, nor do they transmit vibrations, but act as cushions between the driving and driven machines, insuring a steady flow of power from one to the other.

Bearing pressures are low, since no belt tension is employed. The drive occupies very little space. It is silent, clean, unaffected by moisture or dirt, and is claimed to be safe, simple and trouble-proof. Since there is no slip, the speed ratios are fixed and exact. It is durable, and each belt carries its proportional share of the load which has the result of equalizing the wear on them.

These drives, from ½ to 250 hp., with ratios up to 7 to 1 and belt speeds from 800-6,000 feet have already been placed in service. They have been applied to nearly every industry, notably textile machinery, fans and blowers, machine tools, food manufacturing machines, refrigeration, mining, crushing, wood and metal working machinery, elevators and conveyors, paper, flour and rubber mill drives and similar equipment. Tests have been successful and the drives are now placed on open sale.

Electrical Equipment

During the last few weeks a number of new developments in the electrical field of interest to chemical engineering industry have appeared. Among these is the special form of the type CR-7009 magnetic switch brought out by the General Electric Co., Schenectady, N. Y. This switch is provided with a weatherproof inclosing case and roof for use in valve control service where operating conditions require that it be placed in an exposed location or where similar conditions make a case of this type desirable. An additional improvement in this switch is the new latch used with the case. This latch is said to do away with the possibility of jamming or of failure of the latch to close tightly.

Another new development of the General Electric Co. is the redesign of the primary resistance starters for squirrel cage induction motors. Two new types have been brought out, the CR-7056-D-3 in sizes up to 25 hp. and the CR-7056-D-4 in sizes from 25 to 50 hp. Among the improvements embodied in these redesigned starters are magnetic blowouts and arc chutes, improved magnetic interlocks, increased capacity, and improvements in the cases.

New types of motors have also been brought out by the General Electric Co. for crane and hoist service. A direct current motor the type CO-1820, is a fully inclosed motor especially designed for hoist duty. This motor is capable of heavy reversing service and is designed for particularly severe operating conditions. Among the special features are extra heavy shaft and bearings; cast-steel frames, split horizontally; large base; interpoles; and dirt and moisture resisting insulation. The a.c. motors for this service comprise a three-phase motor, type MTC, and a two-phase motor, type MQC. These motors are designed in sizes from 2 to 15 hp. for 60 cycle, two or three phase current at 110, 220, 440 or 550 volts. They are fully inclosed and are designed for intermittent heavy duty with characteristics suitable to the type of service for which they are built. Among the applications of these motors besides crane and hoist service, are rotary car dumpers, larry cars, coke pushers, hydraulic gates and yard locomotives.

The Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., has brought out a new quick-break safety inclosed switch, designated as the type WK-62. This switch is externally operated, totally inclosed, and is provided with a simple quick-break mechanism. It is designed for industrial applications where a disconnect switch is desired.

Another new development of the Westinghouse Elec. & Mfg. Co., is an improved design of vapor-proof unit composed of incandescent globe, holder, socket and gasket. These units have been designed to have a minimum number of parts and still prevent dangerous dusts or vapors from reaching the lamp. The sockets are so designed as to retain all the features of Westinghouse reflector sockets. The globes are threaded to fit cast-iron hoods and to seat on a special gasket which is unaffected by moisture and prevents the vapors or dusts from reaching the bulb. The hood is threaded for ½ in. conduit.

A reflector for incandescent lamps has been brought out by the Westinghouse Elec. & Mfg. Co., which is said to be as efficient as a freshly silvered glass mirror and which will not tarnish or corrode when exposed continually to the weather. The surface of this reflector is also said to be so hard that it can be cleaned with gritty waste without scratching. These features are obtained for the reflector by making the reflecting surface a thin plating of chromium on a copper base. This plating is then polished. When polished it is said to have about the same reflecting characteristics as a silver surface.

Electric Trucks

Two new types of special service electric storage battery industrial trucks have recently been placed on the market by the Elwell-Parker Electric Co., Cleveland, Ohio.

Type EL, shown in Fig. 1, was developed for charging heat treating furnaces and is particularly adapted to the placing of heavy loads in furnaces or ovens. The truck is quite similar to a standard Elwell-Parker elevator truck

Fig. 1—Elevating Truck for Furnace Charging

Fig. 2—Elevating Truck for Carrying Loads of Plate

except for the load supporting platform. This consists of two 92 in. x 8 in. horizontal fingers upon which ten 300 lb. packed furnace boxes can be placed. The bottom of the furnace must be provided with 2 slots to receive the lower flanges of the fingers, which are T-shaped. The furnace floor between and at each side of the slots receives and supports the boxes, pots, or other load when the fingers are lowered and withdrawn. The furnace is set above the floor to provide clearance for the smaller axle thrust beneath the furnace when charging or discharging.

Fig. 2 shows a special elevating truck for handling plate-shaped loads. The load is carried on a forked type platform and the vertical uprights upon which this platform is raised and lowered may be tilted back to an angle of 40 deg. The purpose of this is that, when carrying tinplate sheets, the sheets align themselves so that all edges are even, when they are carried from place to place in this position. The forks fold back when the truck is without load, thus decreasing the overall length.

Manufacturers' Latest Publications

Caterpillar Tractor Co., San Leandro, Calif.—A new folder illustrating the use of gasoline tractors in various fields.

The Foxboro Co., Inc., Foxboro, Mass.—Bulletin No. 148—A new bulletin on dial type indicating thermometers for industrial use.

Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill.—Bulletin No. 75-F—A bulletin describing "Turbinair" portable hoists of the single and double breast type.

Du Pont Everdur Co., Wilmington, Del.—Bulletin No. 5—A catalog giving the properties and uses of "Everdur" noncorrosive metal.

The Central Steel Company, Massilon, Ohio.—A disk-shaped table printed on celluloid showing the composition and proper heat treatment for various alloys and the proper procedure for different methods of heat treatment.

Pioneer Alloy Products Co., Inc., Cleveland, Ohio.—A new folder on valves, cocks, pump parts and castings for chemical and allied industries made from Pioneer Acid Resisting Alloy.

National Carbon Co., Inc., 30 East 42nd St., New York—The third edition of a book entitled, "The Carbon Electrode," being a description of the manufacture and use of carbon electrodes.

The Denver Fire Clay Co., Denver, Colo.—A new folder describing the new and careful method used in packing crucibles and scorifiers for shipment.

The Cleveland Crane & Engineering Co., Wickliffe, Ohio.—A booklet entitled "Mr. Keen Kompetitor," giving some fifty illustrations with photographs of the use of the Cleveland Tramrail System of material handling in various industries.

Mine & Smelter Supply Co., Denver, Colo.—A folder describing crushers, ball mills, pulverizers and other equipment of laboratory size.

The Patterson Foundry & Machine Co., East Liverpool, Ohio.—A new catalog entitled "For The Chemist," describing pebble mills for laboratory use.

Goheen Corporation, Newark, N. J.—A folder describing Rockote for hardening concrete floors.

Industrial Chemical Company, 200 Fifth Ave., New York City—Two new booklets, one entitled "Activated Carbons in the Oil Refining Industry," and the other entitled "The Industrial Application of Activated Carbon."

Chicago Pneumatic Tool Co., 6 East 44th St., New York City.—A new folder describing pneumatic tools adapted for railway use.

Botfield Refractories Co., Swanson & Clymer Sts., Philadelphia, Pa.—Three new leaflets describing Adamant Fire Brick Cement for various types of furnaces.

National Lime Association, 918 G Street, N. W., Washington, D. C.—A new bulletin entitled "Water Softening," describing the use of lime in the treatment of water.

New Departure Manufacturing Co., Bristol, Conn.—A new folder on ball bearings for electric motors.

New Departure Mfg. Co., Bristol, Conn.—Bulletin No. 170 SE—A new bulletin describing the application of ball bearings in a rotary vacuum pump.

W. N. Rockwell Co., 50 Church Street, New York City—Bulletin No. 269—A bulletin giving a method for the selection of fuel for the heat treatment of metal.

Norton Co., Worcester, Mass.—A new booklet giving the history and development of artificial abrasives.

Sumet Corp., Buffalo, N. Y.—A new booklet describing cored and solid bars of Sumet, a specially prepared bearing bronze in soft, medium and hard grades.

Foote Bros. Gear & Machine Co., Chicago, Ill.—A folder describing the continuous tooth herringbone speed reducers made by this company.

General Electric Co., Schenectady, N. Y.—Several new catalogs and bulletins as follows: New General Catalog No. 6001C, being the bi-annual edition of the general catalog, covering the full line of General Electric equipment. Bulletin No. GEA-295, an illustrated bulletin on automatic switching equipment for railway, hydro-electric, mining and industrial service. Catalog No. GEA-257, a catalog of the various items of industrial control equipment manufactured by this company. Bulletin No. GEA-9, a bulletin describing gas-engine driven arc welding sets. Bulletin No. GEA-197, a bulletin describing the type D-54, mechanical drive turbine, which is built in condensing or non-condensing units up to 400 hp. Bulletin No. GEA-233, describing single stage, centrifugal air compressors, for air and gas service. Bulletin No. GEA-235, a bulletin describing steam turbines of 500, 600 and 750 kw., 5-stage, 60 cycle, 3,600 r.p.m. type. Bulletin No. GEA-133, describing electrically operated flow meters for measuring steam, water, oil, gas and other fluids. Catalog No. GEA-178, a catalog of instrument transformers, describing the manufacture and use of this equipment. Bulletin No. GEA-100, a bulletin describing electrical instruments of the laboratory standard type.

American Smelting & Refining Co., Selby Smelting Works, San Francisco, Calif.—Catalog No. 25—A complete catalog of lead and products of lead, including mixed metals in which lead is alloyed with such other metals as copper, antimony and zinc.

Armco Culvert & Flume Mfg. Assn., Middletown, Ohio.—Bulletin on reducing the cost of culvert placement.

Kansas City Testing Laboratory, Kansas City, Mo.—Bulletin No. 21—Bulletin on commercial water, giving general information on composition, sources and treatment of water.

Cross Engineering Co., Kansas City, Mo.—Bulletin No. 20—An illustrated bulletin on petroleum refining, giving some modern methods of gasoline production.

Fisher Scientific Co., Pittsburgh, Pa.—New general catalog of laboratory apparatus and reagents for chemical, metallurgical and biological laboratories.

Crouse-Hinds Co., Syracuse, N. Y.—Two new folders, one describing condulets for fuse cutouts, and the other describing safety hand lamps. Also, a leaflet describing a new service entrance condulet.

Patterson Foundry & Machine Co., East Liverpool, Ohio.—A bulletin describing the type MR dust mill, a new pulverizer for the ceramic field.

Bridgeport Brass Co., Bridgeport, Conn.—A bulletin giving an historical sketch of the development of this company in commemoration of its 60th anniversary.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Two new leaflets, No. 2082, describing centrifugal pumps for boiler feed, and No. 2083, describing an experimental type of grinding mill for laboratories and sampling of such materials as flax seed.

Goheen Corp., Newark, N. J.—Bulletin No. 103—A catalog giving specifications and instructions for painting exterior and interior metal, wood and concrete surfaces, machinery and equipment.

Toledo Scale Co., Toledo, Ohio.—A new folder illustrating various types of scales for industrial work.

Precision Scientific Co., Chicago, Ill.—Booklet No. 102—A new booklet covering electrical specialties for laboratory use. Also, bulletin No. 101, covering water stills.

Steere Engineering Co., Detroit, Mich.—Pamphlets No. 279, 282, 283, 284 and 285—Five new leaflets referring to gas plant equipment.

Filtrol Co., Los Angeles, Calif.—A new pamphlet on the use of Filtrol decolorizing media.

Bausch & Lomb Optical Co., Rochester, N. Y.—A new bulletin describing the slit ultramicroscope No. 22, a new instrument for such purpose as observing colloids in liquids, gases and solids.

Esterline-Angus Co., Indianapolis, Ind.—Bulletin No. 1125—A bulletin describing the use of graphic control instruments in a veneer plant.

Du Pont Everdur Co., Wilmington, Del.—A new illustrated booklet describing the properties of Everdur metal.

Ruths Accumulator Co., 292 Madison Ave., New York City.—A new catalog describing the construction, operation and control of the Ruths Steam Accumulator.

Taber Pump Co., Buffalo, N. Y.—Bulletin 20-1—A pamphlet describing a single suction centrifugal pump.

The Holbeck Engineering Co., Cleveland, Ohio.—A new catalog of pulverized coal systems describing the use and distribution of pulverized coal in various industries, both for boilers and furnaces.

The Columbia Metal Products Co., Dayton, Ohio.—A leaflet describing model F "Dayton" mixer for use with all sorts of stirring, mixing and agitating processes.

Rix Compressed Air & Drill Co., San Francisco, Calif.—Bulletin No. A. B. C. 151. A catalog of high pressure air and gas compressors and boosters, and of vacuum pumps.

Thyle Machinery Co., San Francisco, Calif.—New bulletin describing the Vandercook Thickener.

The McAleenan Corporation, Pittsburgh, Pa.—Catalog No. 4—A new edition of this company's catalog on water tube boilers.

Pittsburgh Electric Furnace Corporation, Pittsburgh, Pa.—Three new catalogs, the first describing the Moore rapid "Lectromelt" electric furnace for iron and steel melting, and also for ferro-alloys, calcium carbide and smelting, in sizes from 50 lb. to 24 tons. The second describes the large model of the "Edmoore" power demand limitator. And the third bulletin describes the small model of this device.

Rome Wire Co., Rome, N. Y.—A new bulletin covering bare wire for electrical purposes giving specifications and reference tables.

Koppers Co., Pittsburgh, Pa. — A new bulletin describing this company's recent developments in apparatus for the removal of naphthalene and gum forming constituents from gas.

The Bethlehem Steel Co., Bethlehem, Pa.—An interesting new book, profusely illustrated, describing the properties and plants of this corporation.

American Spiral Pipe Works, Chicago, Ill.—A new folder on Taylor Forged Steel Flanges.

Automatic & Electric Furnaces, Ltd., 173 Farrington Road, London, England.—Catalog No. 925—A catalog of Wild-Barfield Electro Magnetic Furnaces for the hardening of steel.

Taylor Co., Rochester, N. Y.—Catalog No. 4000—Catalog describing various types of pyrometers made by this company.

The Pfaudler Co., Rochester, N. Y.—Bulletin describing a new type of glass-lined steel evaporating and melting pan.

Schutte & Koerting Co., Philadelphia, Pa.—Bulletin No. 8-A—A catalog of bronze and forged steel valves.

Grindle Fuel Equipment Co., Harvey, Ill.—Bulletin No. 7—A bulletin describing a multi-stage unit pulverizer for pulverized coal installations.

Patents Issued Jan. 5 to Feb. 2, 1926

Paper, Pulp and Sugar

Means for Producing Acid Liquor in Sulphite Pulp Processes. Jacob Darre Jenssen, New York, N. Y., assignor to G. D. Jenssen Company, New York, N. Y.—1,571,271.

Continuous Pulp Beater. Kenneth B. Howell, Maplewood, N. J., assignor to The Barrett Company.—1,568,068.

Process or Method of Making Waterproof Paper Tubes. James H. Carmichael, Lowell, Mass., assignor to U. S. Cartridge Company, Lowell, Mass.—1,571,706.

Paper-Making Machine. Joseph M. Cathcart, Merriton, Ontario, Canada, assignor of one-half to Edwin S. Crabtree, Montreal, Quebec, Canada.—1,568,363.

Method and Apparatus for the Manufacture of Sugar. Albert P. Leonard, New York, N. Y.—1,568,512.

Petroleum Refining

Process for Refining Hydrocarbon Oils. Jacque C. Morrell, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,568,904.

Heat Treatment of Hydrocarbons. Harold R. Berry, Brooklyn, N. Y., assignor to The Dynamics Corporation of America, New York, N. Y.—1,569,532.

Process for Refining Cracked Hydrocarbon Oil. Jacque C. Morrell, Chicago, Ill., assignor to The Universal Oil Products Company, Chicago, Ill.—1,569,872.

Process for Refining Oils. Jacque C. Morrell, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill. — 1,569,870.

Apparatus for Cracking Hydrocarbon Oils. Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,568,400.

Treating Hydrocarbon Oils. Frank W. Hall, Port Arthur, Tex., assignor to The Texas Company, New York, N. Y. — 1,570,890.

Process for Refining Hydrocarbon Oil. Jacque C. Morrell, Chicago, Ill., assignor to The Universal Oil Products Company, Chicago, Ill.—1,569,871.

Oil Still. John Primrose, New York, N. Y., assignor to Power Specialty Company, New York, N. Y.—1,568,182.

Process of Treating Oil. Gustav Egloff and Harry P. Benner, Independence, Kan., assignors to Universal Oil Products Company, Chicago, Ill.—1,569,855.

Method for Treatment of Low-Boiling Hydrocarbons. William F. Downs, Chatham, N. J.; Mary Gardner Downs administratrix of said William F. Downs, deceased. —1,568,812.

Process of Obtaining Commercial Gasoline from Natural-Gas Gasoline. Herman Jan Mackenzie and Alexander Wilhelmus Steenbergh, Tjepoe, Java, Dutch East Indies, assignors to De Bataafsche Petroleum Maatschappij, The Hague, Netherlands. — 1,569,433.

Medium for Bleaching, Cracking and Desulphurizing Petroleum and Other Hydrocarbon Compounds and Process of Preparing Same. Herman Reinbold and Hugo Reinbold, Omaha, Nebr.; said Hugo Reinbold assignor to said Herman Reinbold. — 1,570,005.

Process for Separating the Phases of Emulsions, Particularly of Petroleum, by Means of an Electric Current. Jan Heinrich Christoph de Brey, The Hague, Netherlands, assignor to Naamlooze Vennootschap Batafsche Petroleum Maatschappij, The Hague, Netherlands.—1,570,209.

Method of and Apparatus for Effecting Continuous Distillation. Francis M. Hess, Whiting, Ind.—1,568,157.

Recovery of Aluminum Chloride. Almer McDuffie McAfee, Port Arthur, Tex., assignor to Gulf Refining Company, Pittsburgh, Pa.—1,568,171.

Product Derived from Acid Sludge and Method of Making the Same. Harry T. Bennett, George B. Murphy, and Le Roy G. Story, Tulsa, Okla.—1,568,261.

Process of Making Chlorides. George L. Prichard and Herbert Henderson, Port Arthur, Tex., assignors to Gulf Refining Company, Pittsburgh, Pa.—1,568,181.

Organic Processes

Vat Dyes of the Thioindigo Series. Asa Willard Joyce, Newark, N. J., assignor to The Chemical Foundation, Incorporated, New York, N. Y.—1,568,458.

Process for Manufacturing a Perylene Vat Dye. Alois Zinke and Hermann Shoepfer, Graz, Austria, assignors, by mesne assignments, to Felice Bensa, Genoa, Italy.— 1,569,111.

Carbocyanine Dyes and Process of Making Same. Gurney O. Gutekunst, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,568,667.

Condensation Product of the Anthraquinone Series and Process of Making Same. Paul Schetelig, Basel, Switzerland, assignor to the Firm Society of Chemical Industry in Basle, Basel, Switzerland. — 1,568,627.

Green Sulphurized Dyestuff and Process of Making Same. Emil Reber and Jaroslav Fröhlich, Basel, Switzerland, assignors to Society of Chemical Industry in Basle, Basel, Switzerland.—1,568,622.

Resin Substitute Produced by Friedel Crafts Reaction. Erich Freund and Hans Jordan, Berlin, Germany, assignors to the Firm: Chemische Fabrik auf Actien (vorm. E. Schering), Berlin, Germany.—1,570,469.

Process for Sulphurizing Organic Compounds. Frederick William Atack, Manchester, England.—1,571,181.

Process of Preparing Propylene-Thiohydrin or Propylene-Ethylene-Thiohydrin, and Products Obtained Thereby. Georg Kränzlein, Sindlingen, near Hochst-on-the-Main, and Martin Corell, Hochst-on-the-Main, Germany, assignors to Farbwerke vorm. Meister Lucius & Bruning, Hochst-on-the-Main, Germany.—1,570,262.

Process of Manufacture of Aldehydes, Oils, and Organic Acids from Cacti. William Malcolm Sinclair, Strathfield, near Sydney, New South Wales, Australia. — 1,569,339.

Process of Manufacturing Acetic Anhydride. Rudolf Meingast and Martin Mugdan, Munich, Germany, assignors to Consortium für Elektrochemische Industrie G. m. b. H., Munich, Germany.—1,570,514.

Process of Obtaining Absolute Propyl Alcohol. John A. Steffens, Baltimore, Md., assignor to U. S. Industrial Alcohol Co. — 1,568,349.

Process of Ethylating Amines. Arthur R. Cade, Pittsburgh, Pa., assignor to Carbide and Carbon Chemicals Corporation. — 1,570,203.

Process of Sulphonating Beta Naphthol. Moses L. Crossley, Somerville, and George S. Simpson, Plainfield, N. J.—1,570,046.

Synthetic Manufacture of Methanol. Alwin Mittasch, Ludwigshafen-on-the-Rhine, and Mathias Pier, Heidelberg, Germany, assignors to Badische-Anilin- & Soda-Fabrik, Ludwigshafen-on-the-Rhine, Germany. — 1,569,775.

Cumaron Resin Composition and Process of Making Same. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Co. — 1,570,584.

Compound for Accelerating the Vulcanization of Caoutchouc. Victor Lefebure and Anthony James Hailwood, Manchester, England, assignors to British Dyestuffs Corporation.—1,570,752.

Hard, Resinous Vulcanization Accelerator and Process of Making Same. Winfield Scott, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,571,739.

Method of Manufacturing Rubber Articles and Vulcanizing the Same. Thomas W. Miller, Ashland, Ohio.—1,569,662.

Process for the Manufacture of Cellulose Solutions. Alexander Classen, Aachen, Germany, assignor to The Commercial Alcohol Company, Limited, London, England. —1,570,553.

Preparation of Alkali Celluloses. Emile Van Weyenbergh, Clapham, London, England, assignor to Courtaulds Limited, London, England.—1,569,692.

Inorganic Processes

Process for Obtaining Hydrochloric Acid Free from Arsenic. Erwin Schmidt, Mannheim-Waldhof, Germany, assignor to the Firm Gesellschaft für Chemische Produktion m. b. H., Mannheim-Waldhof, Germany.—1,571,648.

Method of Producing Lead Oxide. Samuel Marshall Evans, Essex Fells, N. J. — 1,570,438.

Process of Recovering Borax from Saline Liquors. Alfred W. Gauger and Henry Herman Storch, Westend, Calif., assignors to Burnham Chemical Company, Reno, Nev. —1,571,002.

Process for the Production of Catalyzers for the Synthesis of Ammonia. Ivar Walfrid Cederberg, Berlin-Steglitz, Germany, assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. — 1,570,333.

Synthesis of Ammonia by Means of Catalysts. Hans Harter, Wurzburg, Germany, assignor to Albert T. Otto & Sons, New York, N. Y.—1,570,485.

Ammonia Soda Process. Hugh A. Galt, Akron, Ohio, assignor to The Pittsburgh Plate Glass Company, Pittsburgh, Pa. — 1,570,299.

Plaster of Paris and Method of Making the Same. Ellery Lewis Wilson, Providence, R. I., assignor to Rumford Chemical Works, Providence, R. I.—1,570,583.

Process for the Treatment of Oxidic Raw Materials. Ture Robert Haglund, Stockholm, Sweden.—1,569,483.

Method of Manufacturing Artificial Abrasives. Clarence J. Brockbank, Philadelphia, Pa., assignor to Abrasive Company, Philadelphia, Pa.—1,568,873.

Apparatus for Production of Hypochlorites and Chlorates. Meyer Wilderman, London, England.—1,568,787.

Recovery of Thiocyanates and Thiosulphates. Marc Darrin, Wilkinsburg, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,570,047.

Process for the Manufacture of Sodium Thiosulphate. Henry Howard, Cleveland, Ohio, assignor to The Grasselli Chemical Company, Cleveland, Ohio.—1,570,253.

Method of Producing Alumina. Rudolf Jacobsson, Kagerod, Sweden.—1,570,353.

Process of Manufacturing Adhesive Blends of Sodium Nitrate and Ammonium Nitrate for Explosive Purposes. William M. Dehn, Seattle, Wash.—1,568,324.

Process for the Extraction of Helium from Gases Containing the Same. Robert Roger Bottoms, Lakewood, N. J. — 1,569,943.

Chemical Engineering Processes

Drier. Elmer E. Anderson, La Grande, Ore.—1,568,436.

Drying Plant. Pilade Barducci, Naples, Italy.—1,571,226.

Humidifier. William B. Hodge, Charlotte, N. C., assignor to Parks-Cramer Company, Boston, Mass.—1,569,860.

Soap Drier. Charles W. Aiken, Brooklyn, N. Y.—1,568,791.

Process of Drying Materials. Michael Doland Jones, Allentown, Pa., assignor to Fuller Fuel Company.—1,568,738.

Ball-Grinding Mill. Povl T. Lindhard, Brooklyn, N. Y., assignor to F. L. Smidth & Co., New York, N. Y.—1,568,752.

Pulverized-Fuel Apparatus. Joseph K. Blum, Scarsdale, and Daniel L. Braine, Brooklyn, N. Y., assignors to K-B Pulverizer Corporation, New York, N. Y. — 1,570,037.

Coking Retort Oven. Joseph van Ackeren, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,570,870.

Apparatus for Electrolyzing Fused Salts of Metals and Recovering the Metals and Acid Radicles. Edgar Arthur Ashcroft, London, England.—1,569,606.

Method of Sizing Cellulose Fibers. Judson A. De Cew, Mount Vernon, N. Y., assignor to Process Engineers, Inc., New York, N. Y.—1,558,845.

Apparatus for Saturating Fibrous Materials. Robert T. Johnston, Brooklyn, N. Y., assignor to The Flintkote Company, Boston, Mass.—1,558,549.

Process of Making Roofing Felt or Like Material. Frederick C. Overbury, Hillsdale, N. J., assignor, by mesne assignments, to The Flintkote Company, Boston, Mass.— 1,558,495.

Method and Apparatus for Making Ceramic Products. Edward Anderson, Dayton, Ohio, assignor to The A. A. Simonds-Dayton Company, Dayton, Ohio.—1,556,193.

Machine and Method of Making Plaster Wall Board. Charles R. Birdsey, Hinsdale, Ill., assignor to United States Gypsum Company, Chicago, Ill.—1,558,459.

Method of Protecting From Incrustations Metallic Surfaces Which Are in Contact with Water or Other Liquids. Walter Thalhofer, Vienna, Austria, assignor to A. G. Für Chemische Industrie in Liechtenstein. —1,558,646.

Process for Compacting, Batting, or Felting Cellulose Fibrous Materials out of Liquids. William F. Boysen, Buffalo, N. Y. —1,557,797.

Process of Purifying Waste Waters. James A. Newlands, Hartford, Conn. — 1,557,188.

Process of Tanning Hides or Skins. John Reginald Blockey, Bolton, England, assignor to William Walker and Sons Limited, Bolton, England.—1,557,011.

Stabilizing Solution Containing Loosely-Combined Oxygen. Victor Wintsch, Jr., Zurich, Switzerland, assignor to R. H. Comey Company, Camden, N. J.—1,559,599.

News of the Industry

Lazote, Inc. Begins Production of Synthetic Ammonia

One unit of the new synthetic ammonia plant of Lazote, Inc., a duPont subsidiary, at Charleston, West Virginia, is being brought into production this month. That part of the plant now under construction will have a daily rated capacity of 25 tons of anhydrous ammonia, and is arranged for ready expansion.

The plant is located on the Kanawha River at Belle P. O., about 10 miles east of Charleston. Both rail and water transport are available. The principal structures are the boiler house, for the generation of process steam; the generator house for the production of coal water gas; the factory building, for the purification and compression of the gases and the synthesis of ammonia; two gas holders, one for water gas and one for hydrogen; condensers and Cottrell precipitators for tar removal; and the cork-insulated ammonia storage house containing Hortonspheres. (See *Chem. & Met.*, November, 1925, page 885.)

A feature of the process is the use of coal water gas, generated from local bituminous coal, as a source of hydrogen. The total generating capacity is 8,000,000 cubic feet of gas per 24 hr. Tar is removed in scrubbers and a Cottrell precipitator, after which the gas —principally hydrogen, carbon monoxide, methane, nitrogen and carbon dioxide—is compressed for purification and fractionation. Carbon dioxide is removed by scrubbing and final absorption in solid caustic soda, and the methane and carbon monoxide are liquefied in a Claude column and sent to the boiler house for fuel. The purified hydrogen is burned in air in a specially designed combustion chamber, the mixture being controlled to yield hydrogen and nitrogen in suitable proportion for ammonia synthesis. The mixed gases are then compressed to 1,000 atmospheres and sent to the catalyst bombs where ammonia is synthesized. The resulting liquid is weighed and pumped to the storage house where it is confined under about 25-lb. pressure in Hortonspheres. Ammonia vapor from the latter is continuously withdrawn to a refrigerating unit for liquefaction and returns to the containers. Shipments of anhydrous ammonia will be made in specially constructed insulated steel tank cars.

The officers and staff of Lazote, Inc., actively engaged in construction and operation of the plant comprise F. A. Wardenburg, vice-president and general manager; J. L. E. Cheetham, superintendent; S. K. Varnes, chief engineer; Roger Williams, chemical director and R. L. Dodge, chief chemist.

New York Chemists' Club Honors William H. Nichols

At a dinner given by the Chemists' Club on January 27 at which William H. Nichols was the guest of honor, a custom was inaugurated that is expected to be continued annually. In

William H. Nichols

selecting Dr. Nichols as the guest of honor at the first of these functions, the Chemists' Club was mindful not only of his eminence and success in the chemical industry, but also of his services to the Club itself.

Professor M. T. Bogert of Columbia University presided as toastmaster. Addresses were made by Professor James F. Norris, president of the American Chemical Society and Frank Bailey, a business friend and associate of Dr. Nichols. Professor Norris recalled Dr. Nichols' relations to the American Chemical Society as one of the three surviving charter members and a past president. Mr. Bailey spoke of Dr. Nichols' benefactions to chemical education and his broad interest in technical education generally. In response, Dr. Nichols modestly disclaimed all of the fine things that had been said about him and acknowledged his indebtedness to his associates and the pursuit of sound business and ethical principles. The dinner was one of the most successful social functions ever held at the Club.

Plans for Developing Helium Supply in Canada

Definite progress toward the establishment of a natural gas research station in the helium recovery plant formerly operated at Calgary, Alberta, and toward the operation of such a plant, was reported at a meeting of the Helium Committee of the National Research Council of Canada, held in Ottawa, Dec. 18. Last Spring, after carefully reviewing the situation arising out of the discovery at Inglewood, Ontario, of natural gas containing a percentage of helium that compares favorably with that treated in the recovery plant at Fort Worth, Texas, the committee made certain recommendations to the National Research Council and at the suggestion of the latter, the Ontario Government secured for the Crown control of the helium right in the natural gas area near Inglewood.

Taylor Addresses Joint Chemical Societies Meeting

Speaking before the joint meeting of the American Electrochemical Society, American Chemical Society, Society of Chemical Industry and Societe de Chimie Industrielle held in New York on Friday evening, Feb. 5, Prof. H. S. Taylor of Princeton University developed some of the newer hypotheses of reaction mechanism, with particular emphasis on the chemistry of contact catalysis. For nearly two hours Professor Taylor held the interest of an audience that taxed Rumford Hall to capacity.

Possibly the most significant part of the discussion was that postulating "an aristocracy of atoms," those atoms the position of which in a space lattice confers properties of marked unsaturation. For example, the corner atoms in a cubical or other 3-dimensional structure would have an energy potential much greater than its neighbors, and would, in the case of nickel catalyst for instance, approach more nearly the properties of gaseous nickel rather than the solid substance. Hence the physical configuration of the catalyst should have an important bearing on its properties, and this is what the experiments of Taylor and others appear to show.

Russia Will Use Waste Matter in Aniline Industry

A report has been presented to the Scientific and Technical Council for the Chemical Industry by P. P. Budnikov, according to the *Commercial and Industrial Gazette* of Moscow, on methods invented by him for the derivation of dyes from waste matters occurring in the manufacture of aniline and alpha-naphthylamine products.

Large Scale Distribution Is Planned for Ethyl Gasoline

Following Favorable Report by Surgeon General's Committee Manufacturers Will Adopt Additional Measures to Safeguard Sale of the Lead-Treated Fuel

RESUMPTION of the national distribution of ethyl gasoline on a larger, but more carefully controlled plan of operation is to be the immediate result of the favorable report made by the Surgeon General's committee in Washington, January 19. In addition to conclusions based on the actual findings in its exhaustive tests, the committee of distinguished scientists suggested a number of possible means of improving the methods of distributing the lead-treated gasoline and of providing more thorough precautions against its misuse. These supervisory measures are being carefully studied by the manufacturers and the Government agencies involved and wherever practicable will be adopted in the new scheme of distribution.

In a sense, then, the Ethyl Gasoline Corporation instead of beginning where it left off with its marketing program eight months ago, will be able to profit by new knowledge of its distribution problems gained during the interim both in its own research laboratories and as a result of the studies made by the Surgeon General's committee. It is understood that the possibility of public contact with the concentrated ethyl fluid, which was thought to have been minimized a year ago when the individual ethylizers were abandoned and bulk mixing substituted, will now be entirely prevented by the adoption of new precautionary measures. This is in line with the committee's suggestions for more definite control of the product in the stages between the manufacture of pure tetraethyl lead and its final sale to the motorist in the 1-1300 dilution which is marketed as ethyl gasoline.

Definite information is not yet available as to which oil companies will market the fuel when national distribution is resumed, but it is believed that the previous licensees will have the first call for the product. Prior to May 5, 1925 when sale was voluntarily discontinued after about 300,000,000 gal. of ethyl gasoline had been distributed over a period of two years, the principal licensees were the Standard Oil Co. (Indiana), the Refiners Oil Co. of Ohio, the Gulf Refining Co., The Standard Oil Co. of Louisiana, Spear & Riddle of West Virginia, the Standard Oil Co. of Kentucky and the Standard Oil Co. of New Jersey. The fact that in the interim some of these companies have turned to anti-knock fuels of their own production is not regarded as a deterring factor in the return to the sale of ethyl gasoline. Most of these anti-knock products, although perhaps adequate to meet present demands have definite limitations. Some, such as that of the Standard of New Jersey were benzol blends; others were special gasolines high in naphthenes and olefine hydrocarbons prepared by cracking processes or derived from specially selected crudes. Ethyl gasoline, however, appears to offer the indefinite expansion in volume and improvement in quality which will undoubtedly be demanded by the automotive requirements of the future.

Reports Favorable Conclusions

The committee which was appointed by Surgeon General H. S. Cumming after the public conference held in Washington on May 20, 1925 consisted of Dr. William H. Howell of Johns-Hopkins, Chairman; Prof. Julius Stieglitz of Chicago, Dean David L. Edsall and Prof. Reid Hunt of Havard, Prof. C. E-A. Winslow of Yale, Dr. W. S. Leathers of Vanderbilt, and Dr. A. J. Chesley, State Health Officer of Minnesota. The actual conduct of the investigation was under the direction of Dr. J. P. Leake, surgeon of the Public Health Service. Surgeon General Cumming and Surgeon L. R. Thompson, in charge of Industrial Hygiene and Sanitation, also collaborated with the committee and the investigators.

It was early determined that the crucial test of the situation must be derived from actual experience in handling ethyl gasoline under practical conditions of operation. Accordingly observations were begun in Dayton and Cincinnati on 252 individuals divided into five groups: A. 36 commercial automobile drivers who had never used ethyl gasoline; B. 77 garage employees who had used it constantly for over two years; C. 21 garage workers and service station employees unexposed to gasoline containing lead; D. 57 similar workers in garages and stations handling ethyl gasoline; and E. 61 men employed in two industrial plants known to offer serious exposures to lead.

On the basis of its investigation the committee reported the following general conclusions:

(1.) Drivers of cars using ethyl gasoline as a fuel and in which the concentration of tetraethyl lead was not greater than one part to 1,300 parts by volume of gasoline, showed no definite signs of lead absorption after exposures approximating two years.

(2.) Employees of garages engaged in the handling and repairing of automobiles and employees of automobile service stations may show evidence of lead absorption and storage, as indicated by the lead content of the feces and the appearance of stippled cells in the blood. In garages and stations in which ethyl gasoline was used, the amount of apparent absorption and storage was somewhat increased, but the effect was slight in comparison with that shown by workers in other industries when there was a severe lead hazard. (Group E) and for the periods of exposures studied was not sufficient to produce detectible symptoms of lead poisoning.

(3.) In the regions in which ethyl gasoline has been used to the greatest extent as a motor fuel for a period of between two and three years, no definite cases have been discovered of recognizable lead poisoning or other disease resulting from the use of ethyl gasoline.

In view of these conclusions, the committee further reported that "in their opinion there are at present no good grounds for prohibiting the use of ethyl gasoline of the composition specified, as a motor fuel, provided that its distribution and use are controlled by proper regulations."

Large Attendance Expected at A. I. M. M. E. Meeting

The story of recent progress in the technology and economics of the important mining and metallurgical industries of the United States will be told in more than one hundred papers and addresses before the 133rd meeting of the American Institute of Mining and Metallurgical Engineers, to be held in the Engineering Societies Building, New York, February 15-18. Indications are that the meeting will be the largest from the standpoint of attendance in the history of the Institute. The Institute's membership of nearly 9,000 engineers, while naturally for the larger part located in the United States, comprises the names of distinguished engineers residing in all parts of the world. Student societies affiliated with the Institute have been organized at forty universities and colleges.

Important scientific problems affecting the coal-mining industry, the various branches of metal mining, the important non-metallic mineral industries, the vast petroleum and natural gas industries, and the different metallurgical trades will be discussed by specialists whose researches have contributed materially to the advancement of technical knowledge in these fields.

Waste of Gas in Manufacture of Carbon Black

Following its recent denial for a number of petitions for burning gas in manufacturing carbon black in different parts of the state, the Texas Railroad Commission, Judge H. E. Bell, chief oil and gas supervisor, points out to what extent the petitions were refused—a total of 14,000,000 cu.ft. of gas was denied for daily burning for such purpose. The commission, it is set forth, finds as a matter of fact that 70,000,000 cu.ft. of gas coming from oil sands in oil wells and passing through gasoline plants is now blown daily into the air in Stephens County alone, a total loss to the landowners, the gasoline manufacturers and the public at large. Further, it finds that the Phillips Petroleum Co. is shutting in oil wells in the Ibex field of Shackelford County and, with these oil wells, 30,000,000 cu.ft. of gas, waiting for a market for this gas. Taking the quantity noted as being wasted in the Stephens County districts, and the addition of that which should be produced in Shackelford County, the commission sets forth that there is an aggregate surplus and waste in these two counties alone of 100,000,000 cu.ft. of casinghead gas per day.

Equipment Makers To Give Lecture Series

Carnegie Institute, Columbia, and Ohio State Joint Sponsors

The 1926 series of lectures has been arranged by the Association of Chemical Equipment Manufacturers under the joint sponsorship of Carnegie Institute of Technology, Columbia University, Ohio State University and the Association, to be delivered at the three educational institutions. The lectures embrace a fairly comprehensive range of practical processing topics and comprise a wider and more carefully arranged series than the association has heretofore provided. Such subjects as filtration, industrial heating by oil circulation, corrosion-resisting chemical equipment, high chromium steels, and specially difficult problems in welding chemical equipment will be discussed by qualified technical representatives of member Association companies.

In announcing the schedule of lectures, G. O. Carter, President of the Association states:

"The expanded and carefully arranged 1926 lecture program marks a further advance in the effective expression of the purpose of the Association of Chemical Equipment Manufacturers to promote throughout American industry and technical circles, a practical and profitable knowledge of the processing idea in production.

"This purpose finds an expression of a different sort in the Chemical Equipment and Process Engineering Expositions managed by the Association, the second of which occurs in Cleveland, May 10-15, inclusive, 1926.

"The Chemical engineering profession and all of the interests and agencies involved in the maintenance and further development of processing technology, as well as the producers and distributors of process equipment, benefit from the promotion of the Association's work of this character."

The following is a list of the lectures scheduled for delivery:

Columbia University

Feb. 13, A. E. Marshall, Corning Glass Works, "Glass as an Industrial Material."

Feb. 24, W. M. Corse, Duriron Co., Inc., "Ferrosilicon and Copper-Aluminum Alloys in the Chemical Processes."

March 2, E. C. Alford, Duriron Co., Inc., "Corrosion-Resisting Chemical Equipment."

March 16, Charles Fuhrmeister, Jr., Oliver Continuous Filter Co., "Continuous Filtration."

March 19, A. B. McKechnie, Parks-Cramer Co., "Industrial Heating by Oil Circulation."

April 12, C. E. McQuigg, Carbide & Carbon Research Laboratory, "High-Chromium Steel."

April 16, J. A. Baker, The Dorr Co., "The Application of Continuous Methods to Wet Chemical and Metallurgical Processes."

Carnegie Institute of Technology

Jan. 14, G. O. Carter, Linde Air Products Co., "From Test Tubes to Production."

Jan. 21, E. E. Thum, Linde Air Products Co., "Special Difficult Problems in Chemical Equipment."

Feb. 4, A. B. McKechnie, same subject as above.

Feb. 11, Dr. C. L. Knowles, The Dorr Co., Same subject as that of J. A. Baker above.

Feb. 13, A. E. Marshall, same subject as above.

Feb. 25, W. M. Corse, same subject as above.

Ohio State University

Jan. 22, E. E. Thum, same subject as above.

Feb. 5, A. B. McKechnie, same subject as above.

Feb. 12, J. V. Slade, The Dorr Co., same subject as that of J. A. Baker above.

Feb. 19, Charles Fuhrmeister, Jr., same subject as above.

Feb. 26, W. M. Corse, same subject as above.

March 5, E. C. Alford, same subject as above.

March 12, C. E. McQuigg, same subject as above.

News in Brief

Annual Convention of Chemists in Canada—The annual Canadian convention of chemists under the joint auspices of the Society of Chemical Industry and the Canadian Institute of Chemistry will be held in Montreal on May 31, June 1 and 2. It is expected that many of the American chemists will be present and any desiring to present papers should communicate before March 1st with H. W. Matheson, Room 602 Power Building, Montreal, chairman of the programme committee, stating subject of the paper. Those desiring to receive convention literature, may communicate with M. C. Coll McFee, Secretary, 164 Hutchison Street, Montreal.

Exposition of Chemical Industries in Japan—An exposition of chemical industries will be held at Tokyo, Japan, beginning March 19 and continuing to May 17. The honorary president of the exposition is His Imperial Highness, Prince Kuni, and its officers and advisors include a number of the leading statesmen, business men and scientists in Japan.

Boll Weevil Hibernation Above Normal—In spite of the fact that climatic conditions have been unfavorable for the boll weevil during the last two years, the number of boll weevils entering hibernation at various points in the cotton belt last fall was higher than in any of the previous years, except one, for which records are available. Weevil hibernation this winter is decidedly above the normal average. This is shown by studies which the Department of Agriculture has made at points in Louisiana, North Carolina, South Carolina, and Georgia. Cotton farmers are warned by the department not to conclude, from the comparative immunity from boll weevil infestation which they have had during the last two years, that similar conditions will exist in 1926.

University of Chicago To Expand Chemistry Department—The Department of Chemistry of the University of Chicago recently announced the formation of a Chicago Citizens' Committee on Chemistry. Headed by Charles H. MacDowell, president of the Armour Fertilizer Works, the committee is to work in collaboration with the University in an attempt to raise $3,235,000 for a new laboratory building, adequate endowment, and the establishment of new professorships. The development plan involves strengthening the research staff by adding professors of first rank in their respective fields, and providing new buildings needed with laboratories to be devoted exclusively to graduate and research work.

Dunkle Appointed To Research Fellowship at Carnegie Institute—C. G. Dunkle, secretary of the Pittsburgh Section of the American Chemical Society, and a former chemist with the H. J. Heinz Co. in Pittsburgh, has been appointed to a research fellowship in mining and metallurgy at the Carnegie Institute of Technology, according to an announcement. This appointment fills a vacancy caused by the death of Benjamin E. Hess, of Los Angeles, Cal. and a graduate of California Institute of Technology, who was killed on December 19 in a train wreck near Altoona, Pa.

Another $250,000 for Petroleum Research—The Universal Oil Products Co. through its president H. J. Halle has notified the American Petroleum Institute that it will contribute $250,000 for petroleum research. This sum is for the purpose of furthering and enlarging the plans and work to be done in scientific research in petroleum initiated by the fund of $250,000 recently pledged by John D. Rockefeller.

Annual Meeting of American Engineering Council—The annual meeting of the American Engineering Council was held in Washington Jan. 13-15. It was announced that the council had secured $25,000 with which to defray the expense of its survey for 1926. This survey will deal with safety in industry. Officers for the ensuing year were elected as follows: president, Dean Dexter S. Kimball of Cornell University, vice-presidents, Gardner S. Williams, Ann Arbor, Mich., O. H. Koch, Dallas, Tex., I. E. Moultrop, Boston, Mass., and A. W. Berresford, New York City. Dr. H. E. Howe, Washington, D. C., was re-elected treasurer and Col. John H. Finney of Washington, chairman of the finance committee. L. W. Wallace was again chosen as executive secretary.

Enjoins Use of Secret Data By Former President—A permanent order was issued at Newark, N. J., last week, restraining Dr. Henry V. Walker from using in his present position with Miner-Edgar Co., secret data which he acquired while president of the Maas & Waldstein Co. The original restraint was granted last October when Dr. Walker severed his connection with Maas & Waldstein Co. and entered the Miner-Edgar Co.

News from Washington

By Paul Wooton

WASHINGTON CORRESPONDENT OF *Chem. & Met.*

WITH prospects favoring a domestic production of over 100,000 tons of atmospheric nitrogen products (computed as ammonium sulphate) within a year, there is increasing interest in the effect of this development on our by-product coke and gas industries.

While the situation in this country is not entirely parallel with that in Germany, it is sufficiently similar to give an idea of what may happen here. Ammonia made from atmospheric nitrogen is so much more in demand for many major uses that in Germany by-product ammonia has no important market except in the form of ammonium sulphate for fertilizer. This has reduced the profits of coking and gas production.

In this country an educational campaign among the farmers would be necessary if any large percentage of them are to be induced to change from Chile nitrate to ammonium sulphate. The organization that could undertake that work most convincingly is the Department of Agriculture. Heretofore there has been some reluctance on the part of the Department to undertake that task for ammonium sulphate alone, because of its hope that such an effort could be undertaken on behalf of all concentrated fertilizers. Recently, however, the Department has come to regard concentrated fertilizers less optimistically and it may be willing to enlist in the effort to insure for the farmers every possible saving which can be effected by the substitution of ammonium sulphate for nitrate of soda. Germany, however, finds no inconsistency in preaching ammonium sulphate along with appeals to use such materials as urea and the higher concentrates of nitrogen.

The amount of nitrogen going into German fertilizers will be doubled next year. Under German policy this can be decreed in advance. There is an embargo on imports of nitrogen so the producers of synthetic nitrogen, backed by the authorities, are in a position to dictate to the fertilizer manufacturers the amount of each kind of nitrogen they must use. Refusal to comply would cause all supplies of any kind of nitrogen to be withheld. Thus a home market will be provided in Germany for a part of the large increase in nitrogen production which is being planned for 1926.

Muscle Shoals Proposals

Muscle Shoals has entered a new cycle of activity during the past month. Following passage by the House of a concurrent resolution, providing for a joint Congressional committee to receive bids for the government's properties, the resolution ran into stiff opposition in the Senate committee.

After exhaustive hearings it became apparent that a majority of the members of the committee were inclined to oppose the resolution. Just before the committee was scheduled to vote on the measure the President sent for seven members of the committee and urged them to support the resolution on the ground that some definite action should be taken at this session and that this resolution seemed to hold out more prospect of action than other legislation.

This rather unusual action by the President is credited with having prevented the amendment of the resolution in the committee. The principal amendment would have required the distribution of all power not required for fertilizer manufacture. Another amendment proposed the elimination of the reference to the Ford offer.

Some members of the Senate committee regarded with suspicion the use of the word "lease." They proposed that the plural be used. This met with objection from the House and gave rise to the claim that the resolution had been drafted in such a way as to give advantage to a single prospective bidder. Another point made in that connection against the resolution was that it did not require the separation of fertilizer and power features of the project.

Following the conference with the President, the committee voted to report the resolution favorably without amendment. As this is written the resolution is on the Senate calendar.

It is recognized that the real issue involved is whether the bulk of the power is to be used for public utility purposes or for electrochemical industries. There is a growing tendency to believe that no large amount of power will be used at Muscle Shoals for fertilizer production at the present time.

In the meantime the power plant at the Wilson dam is nearing completion. The four Westinghouse generators have been tried out and are in operation. The power is being sold to the Alabama Power Company. The line capacity does not permit the full output of the four generators to be carried away from Muscle Shoals. The four General Electric generators are nearing completion. The main switchboard is in place and the House has voted the money necessary to purchase transformers. At present the Alabama Power Company has furnished its own transformers but they are intended for another development.

No plans have been made as yet by the Senate Foreign Affairs Committee to take up the Geneva protocols dealing with the international traffic in arms and the use of gas in warfare.

So far as is known there will be no serious opposition to the proposed treaty dealing with the arms traffic. The gas protocol will be opposed vigorously. Before the committee acts ample opportunity will be given those interested to be heard.

It is expected fully, however, that the committee will recommend the ratification of the gas protocol, but its opponents are placing reliance in Senator Wadsworth of New York, to lead a successful fight on the floor.

Important Alcohol Decision

While the decision of the court in Philadelphia in the alcohol permit case has not been analyzed carefully, at the time of this writing, the feeling in Washington is that it will set back materially Gen. Andrews' far-flung campaign against the diversion of alcohol into beverage channels.

There is doubt as to the construction to place on the court's decree that the permit privilege cannot be terminated except in the manner provided by statute. Apparently there will be a period of uncertainty, expected by some to be bad alike for enforcement and for the alcohol industry.

There has been a decided decrease in the diversion of industrial alcohol during recent months. This is attributed by some members of Congress to Andrews' effort to revoke questionable permit. As a result legislative efforts, intended to offset the Philadelphia decision, are expected.

Secretary Mellon's plan for a separate bureau of Prohibition has the approval of the President and apparently will meet much less opposition than did the Cramton bill at the last session. The radical drys do not like it as well as their own child but they hardly are in a position to do anything to impede its passage.

Under the new proposal the Commissioner of Prohibition is to be appointed by the Secretary of the Treasury who is to delegate such powers as he deems advisable to the commissioner for the administration and enforcement of the prohibition statutes.

The bill provides specifically that the Commissioner of Internal Revenue shall surrender his powers in this connection. It is believed that any effort to have the Commissioner of Internal Revenue retain control over industrial alcohol would be futile.

Only intermittent production of methanol in Germany is expected until the termination of the agreement between the Stickstoff Syndicate and the hardwood distillers. Moreover the German producers want to keep the price to their domestic trade at a point where it will permit of a substantial profit. This acts as a restraint on low prices on foreign business as the producers are anxious to keep clear of anti-dumping statutes.

The Germans are said to be trying to create the impression that their costs are around forty cents. While it is recognized that early reports of low production costs were in reality only processing costs, yet it is believed that Germany is in a position to sell at twenty-five cents or slightly less and is in a position to make the market whenever it is to her interest to do so. Such a situation, however, may not last long as domestic production of the synthetic product is about to begin.

Favorable Prospects Confront British Chemical Industry

Many New Rayon Companies Will Be Placed In Operation—Government Subsidy an Aid to Beet Sugar Production

(From Our London Correspondent)

LAST year closed on a relatively cheerful and hopeful note, to which many factors have contributed. The basic industries such as iron and steel, textiles, and even coal are showing distinct signs of improvement or hope, and the evidence given before the Royal Coal Commission in particular is such as to enable the community to believe that after all the specter of an industrial conflict next May may be laid.

The reorganization of the capital of firms like Vickers, Limited, and the British Dyestuffs Corporation to values more in keeping with their assets and prospects, is regarded as a good sign, as dividends could not be distributed without this method of putting one's house in order and it may have been held that the right time to do this is when a dividend is in prospect. As regards coal, the anthracite strike in the United States has helped South Wales, where apart from exports of anthracite, works making anthracite ovoids are working full time or being restarted. A notable instance is that of the Cambrian Fuel Works, at which commercial trials with "pulp binders" have been proceeding for some time and it is expected that commercial production with this new smokeless vegetable binder will proceed on an increasing scale during the next few months. Details of the process were published in *Colliery Engineering*, London, of December and also in the Proceedings of the South Wales Institute of Engineers.

New Rayon Companies

It has not taken long for the technical, industrial and financial interests to take advantage of the way in which public interest and imagination have been stimulated by the phenomenal success of the Courtauld concern. Some ten new companies, each with a capitalization of $1,500,000 or upwards, already have been formed and others are in prospect. Chief interest centers in the S. N. I. A. Viscosa, operating the corresponding Italian process, the Western Viscose Silk Mills, of which Sir Max Muspratt, Chairman of the United Alkali Co., is a Director, The Nuera Art Silk Co., with Dr. Herbert Levinstein on the Board, and Apex Artificial Silk, Ltd. The last named is of particular interest as being the only one to propose manufacture of acetyl cellulose silk with English Patent 240,624 of Dr. L. A. Levy as the basis. The original manufacturers under a process of this type—British Celanese, Ltd.—appear still to be under a cloud and acrimonious discussions in regard to its alleged mismanagement are again in progress. The general opinion is that these new companies are undercapitalized and that after a time they will exist or prosper mainly because Courtaulds, foreign competition, and the silk duties allow them to do so—always provided there are not too many of these new organizations. In some cases, a substantial part of the issue has been left with the underwriters.

The Apex company is perhaps an exception inasmuch as their field is relatively new. The main patent consists fundamentally in the addition of nickel cobalt and chromium salts to the acetylating mixture, but it is believed that this feature is not of outstanding utility and it is known that Courtaulds can start the manufacture of similar products whenever it suits them to do so. A curious feature in all these new companies is the absence of any reference to chemical engineering and of chemical engineers in an advisory capacity, and this for an industry which is largely dependent on engineering and textile knowledge, the absence of which has meant failure in similar cases.

Subsidy for Beet Sugar

Beet sugar factories are still springing up all over the country and the Irish Sugar Manufacturing Co. has at last started construction at Carlow, Leinster, under Belgian, Irish and Czechoslovak auspices. A subsidy of $100 per ton is to be granted for 10 years by the Government. In the case of nearly all these sugar factories it is almost impossible for American supplies of plant to secure orders, these being usually already arranged for before any announcement is made. As a result it is quite possible that the factories will not work at the highest efficiency until such time as free scope is given as regards the installation of plant of the best type. Supplies of beet from the farmers have in some cases, been less than those contracted for.

Technical Developments

Fuel economy and carbonization problems are still responsible for much controversy and patent literature. A hydrogenation process for cracking low temperature tars and for obtaining a high yield from crude benzol is attracting considerable attention. Low pressures and temperatures are used and a yield of 70 per cent of light spirit and an almost theoretical yield of refined benzol are reported. Success has also attended the filtration of tar to obtain after distillation a pitch containing substantially no free carbon.

The problem of preventing pollution from the oil discharged with water from the fuel tanks of steamers appears at last to have been solved by the Stream Line Filter Co., the full size apparatus tested and purchased by the British Admiralty having been on view at the Machinery and Shipping Exhibition.

Good progress is being made by Adco, Limited, with their fermentation process for the manufacture of synthetic stable manure from straw and vegetable waste of all kinds. A similar proposal has been made for the treatment of tannery waste.

Rumor is still rife in regard to the future of the British Dyestuffs Corporation and the possibility of a working arrangement being reached with the German Combine, in connection with which it is realized that there is no question but that the interests of this country in regard to supplies on emergency and for the maintainance of an adequate number of trained organic chemists will be properly safeguarded. Other rumors in regard to impending changes in the directorate are likely to prove correct and it would appear that the intention is to strengthen the technical side of the Board and also the technical and research staff. Whether more attention will be paid to chemical engineering knowledge, both in this concern and in many others, remains to be seen, but there is no doubt whatever that in this country the chemical engineer is likely to come into his own, thanks, in considerable measure, to the steady work which has been carried on under the auspices of the Institution of Chemical Engineers and kindred organizations. This view has recently received support in the suggestion made for the conversion of the Finsbury Technical College into a school of chemical engineering and by the gradual conversion of what was formerly an active opposition to whole hearted support.

The Manchester Guardian Commercial is to start a new Chemistry and Chemical Engineering Section. Certain changes are also impending in regard to the *Journal* of the Society of Chemical Industry and in general, this year promises to be full of interest and the prospects of British Chemical industry seem brighter than for many months.

Potash Deposits Found in Texas and New Mexico

Promising sources of potash in the salt beds of western Texas and southeastern New Mexico have been discovered that may check the domination of the potash market in the United States by foreign producers, according to a Geological Survey report issued on Jan. 30.

The report shows that these beds are likely to be thick and extensive, suggesting large potash salt deposits and while the samples obtained have not shown conclusively whether the potash is present in commercial quantity indications point in that direction. The discovery was made through the drilling for oil in these regions where the cuttings have revealed potash salts such as are found in Germany and France.

Markley Heads Canadian Clay Products Association

D. C. Markley, of Ottawa, Ontario, was elected president of the National Clay Products Association at the annual meeting held in Toronto on January 26. F. B. McFarren, of Toronto, was elected first vice-president; H. F. Dingledine, of Aldershot, second vice-president; A. W. Cote, of Cooksville, Ont., third vice-president, and Gordon C. Keith of Toronto, secretary-treasurer.

Government Will Aid Development of Nitrogen in France

Bill Proposed To Form Commercial Limited Society in Which the State Will Participate

From Our Paris Correspondent

THE Franco-German negotiations, resumed on December 15 recently reached a culminating point. If the Germans did not obtain the status of a most favored nation, for all practical purposes they got what they wanted. They held firmly to the demand for favored relations and the result is unmistakably, whether we will it or not, a victory for German tenacity. What will the chemical industries of our country become with this agreement? If possible agreements between French and German chemical industries do not intervene, everything is to be feared for us. Let us not forget that one of the chemical experts delegated by the German Government is the Dr. Ungewitter, author of the book entitled Chemisch Industrielle Wirtscheftspolitik 1923/1924, a book which appeared a year ago but which comes to the fore with the present negotiations.

This book sets forth numerous statistics which are unquestionably interesting. These statistics not only give an idea of the importance of the German chemical industry considered in itself, but likewise emphasizes the importance of this industry among the similar industries of the world. The impression of this book is that of a self-conscious power having firmly and clearly directed purposes towards the battle on a ground wherein the German chemists know themselves to be masters, if not as scientists at least as industrials.

Fixation of Nitrogen

Owing to the present situation of the French budget, the French Government can vote no adequate appropriations for the enterprise of the fixation of nitrogen which it created at the Poudrerie de Toulouse. That is why, rightly willing that the business wherein 150 million francs have already been engaged, should carry on, it has decided to appeal to public subscription to obtain the funds necessary to complete the plants and establish the industry. A bill has therefore been introduced to create a National Society of Azote with a capital of 250 million francs which will be a commercial limited society with the participation of the state.

The control of the synthetical ammonia plant of Toulouse was handed over to the Office National Industriel de l'Azote, an organism created by the law of April 11, 1924. The bill introduced with the view of creating the aforesaid limited society, explains that at least 175 million francs are necessary for the installations required for the daily fixation of 100 tons of nitrogen. Now the 150 million francs granted by the state will very likely be absorbed before July 1 without even the hope of producing at that time a single kilogram of nitrogen. Hence the decision of floating a loan. The capital of 250 million francs will be divided into two equal parts of 125 millions each. The first part will be represented by shares in kind, named A shares, handed over to the state; the other part is represented by shares, called B shares, opened to public subscription.

The Stearine Industry

There are in France 15 plants engaged in stearine manufacture, 12 using lime saponification and 3 using saponification with subsequent distillation which gives a larger yield in solid acid; finally 2 practising the hardening of the oils by hydrogenation. The return of Alsatia has added to the French plants the important stearine plant of Haehl in Strasburg. The output of the stearine plants is 30,000 tons of stearine and 35,000 tons of oleine obtained as by-product and utilized in the making of soap. The French industry of stearine is experiencing very difficult times. The Société de Stéarinerie et Savonnerie has just published its balance-sheet for the year 1924/1925. It lost, roughly speaking, one million francs. The chief reason of this is the geographical situation of the plants and it appears that this reason will eventually drive this society to limit their activity if not to discontinue entirely.

The French soap plants are not so large as the English plants. They are of comparatively minor importance and much scattered all over the territory, which explains the fact that they are interested in turning out products of a superior brand rather than to aim at a heavy production. The French output is 345,000 tons of soda soap and 15,000 tons of potash soap (figures of 1913). The export is of about 36,000 tons which leaves a home consumption of about 327,000 tons, that is to say an average of 8 kilogram per inhabitant. The war has very likely influenced this fabrication except for the supply of oils and greases; in this case it is often England who, in the French colonies, gathers the oils and then imports them in France. One of the greatest centres for the treating and refining of oil is Marseilles. Then there is also the centre of Roubaix whose textile and tinctorial industries consume much soap.

As regards supplies of fats, France, like other European nations, is dependent on other countries. It hardly produces 30,000 tons of vegetable oils and 30,000 tons of animal fats, of which 15,000 tons are edible tallow and 15,000 tons, industrial tallow. It therefore imports tallow and lard from the United States but, on the other hand, exports considerable quantities of butter.

With regard to vegetable oils, France imports from her colonies 280,000 tons of oleaginous seeds and from foreign countries 743,000 tons, corresponding to a consumption of 400,000 tons of oil (of which 45 per cent is peanut oil). Two thirds of this consumption is for edible purposes and about one-third for industrial purposes. Our needs have increased since the return of Alsatia. We can therefore make an estimate of our importation of oleaginous seeds to be about 1,200,000 tons corresponding to about 500,000 tons of vegetable oils while our consumption of animal fats has grown to about 50,000 tons.

Debenzolizing of Gas

Two decrees promulgated in the law of July 22, 1923, have been published by which the two most important French gas producers the Société du Gaz de Paris (for Paris) and the Société d'Eclairage, Chauffage et Force Motrice (for the suburbs) are obliged to build within a definite time the necessary installations for the debenzolizing of all their gas production and to maintain these installations in perfect working order. We can foresee that when these prescriptions have been realized the French production of benzol will be at least of 15,000 tons.

Analogous decisions are pending for the chief gas plants of the country after a particular study of each case by a commission specially instituted by a decree of January 15, 1925, and which is presided over by the director of the Office National des Combustibles liquides.

Government Board To Control Kauri Gum Industry

A report from Consul Walter F. Boyle at Auckland says that by an act of the New Zealand Parliament, known as the Kauri Gum Control Act, the government of New Zealand has provided for the control of the kauri gum industry by a board clothed with power to direct the marketing, and, if necessary, monopolize for the benefit of the producers the output of kauri gum.

This act will come into force on April 1, 1926, that is, by that time the Control Board will be organized and ready to enter on its functions.

The board is to consist of five members, two of them representing the New Zealand government, one of whom shall be a person having expert knowledge of the kauri gum industry, two to be elected by the producers, and one to represent the exporters, who is to be appointed by the government rather than elected and must be neither directly nor indirectly engaged in the kauri gum trade.

The board is empowered to appoint agents in places beyond New Zealand. It is empowered to prohibit the export of kauri gum except under license, to assume control of all kauri gum produced in New Zealand, and gum thus controlled may only be sold or disposed of by direction of the board.

The board is also clothed with special power to acquire lands, buildings, plants, machinery, etc., for the purpose of receiving, recleaning, regrading and otherwise preparing kauri gum for sale either in or beyond New Zealand.

The board may also purchase kauri gum by payment in full or by means of advances. For the purpose of raising funds for the purchase of, or advances on kauri gum, the board is authorized to pledge the gum under its control as security.

British Visitors Impressed by American Prosperity

Greatly increased production efficiency, stability of commodity prices, and amazing general prosperity were chief among the impressions reported by Col. F. Vernon Willey and Guy Locock during their recent visit to the United States as representatives of the Federation of British Industries. In their report, the visitors freely predicted an early participation of the United States in world trade on a scale that would seriously threaten the supremacy of Great Britain in many quarters. This prophecy is based on America's remarkable production organization, sound financial position and signs of general prosperity.

An interesting observation by the visitors was that in the face of general prosperity, prices had failed to rise. "Normally one would have expected that the enormous influx of gold into the United States would have tended to raise prices substantially by forming the basis of credit expansion, and that the undoubted strength of the demand for commodities would have operated in the same direction. This, however, has not been the base, and American prices have not risen as anticipated. During the last two years there has been a spirit abroad among the consuming public in the United States, which is often referred to as "the consumer's strike." In other words, the producer has been unable to raise his prices because if he did so, he would not sell his products. The failure of American prices to rise as predicted is all the more remarkable in view of the enormous expansion of the deferred payment system, which of course operates toward creating credit in the present by anticipating the future, and may be said to be a species of inflation."

Regarding increased production efficiency, it is important to note this observation. "In the last ten years the volume of railway freight has increased by 25 per cent, while the number of employees has remained stationary." The reasons generally attributed to this increase in efficiency are (1) the spread of both general and technical education, (2) restriction of immigration, (3) high wages, (4) unrestricted output and utilization of labor saving devices and (5) satisfactory relations between employers and employed.

Regarding our industrial organization, the report credits the United States with attainments never equalled in any other country, with the possible exception of Germany. This is explained as follows: "In individual businesses the tendency is toward the larger unit, and this tendency is likely to become more and more marked. Apart from this movement toward amalgamation, there is far more readiness in America than in Great Britain for the different firms in one industry to co-operate for their mutual good, and even to go so far as to pool a great deal of their technical and business experience. The American convention habit may be somewhat overdone and may appear to consume a great deal of time, but there is no doubt that the habit of meeting together frequently and exchanging experiences has proved to be of great value to American industry."

Standard Varnish Works and Toch Brothers Combine

Announcement is made by J. W. Robson, president of the Standard Varnish Works, that two of the oldest concerns in the paint and varnish industry in this country have combined through the acquisition by the Standard Varnish Works of all of the capital stock of Toch Brothers, Inc. The latter company has been continuously under the management of one family since its foundation in 1848, and will so continue with Henry M. Toch, president, Maximilian Toch, vice-president, and Harry E. Baer, secretary-treasurer. This amalgamation will permit the rapid expansion of Toch Bros., Inc., through the additional facilities afforded by the large plants of the Standard Varnish Works at Elm Park, N. Y., Chicago, London, Paris, Berlin, Milan, Barcelona, and a newly completed lacquer factory at Linden, N. J.

The manufacture of the Toch Bros., Inc., products will be in charge of Dr. Maximilian Toch and Arthur D. Robson, vice-president in charge of operations of the Standard Varnish Works. Henry M. Toch has become chairman of the board of the Standard Varnish Works. The financial matters of the company will be in charge of James S. Wolf, treasurer of the Standard Varnish Works. The management of the Western division remains in charge of J. Heath Wood, president of the Standard Varnish Company of Illinois. As Dr. Maximilian Toch becomes vice-president of the Standard Varnish Works, this concern will have the services of one of the world's recognized leading paint and varnish chemists, who will devote his entire time and attention to the development and manufacture of the Standard Varnish Works and Toch Bros., Inc., products.

This is the third important announcement issued by the Standard Varnish Works since the installation of its present management barely a year ago, following as it does news of the completion of a large and modern lacquer factory, and the acquisition of the Standard Varnish Co. of Illinois, which was originally part of the Standard Varnish Works, but was separated from it in 1918.

Canadian Research in Pulp and Paper Industry

An important feature of the thirteenth annual meeting of the Canadian Pulp and Paper Association held in Montreal, January 27 to 29 inclusive, was an outline given of Canada's plan for co-operative research in the pulp and paper industry.

There are three parties to the plan: The Dominion Government, the Canadian Pulp and Paper Association, and McGill University. Annually, the Dominion Government is granting $35,000 to the work of co-operative research through the Forest Products Laboratories; the Canadian Pulp and Paper Association gives a sum of not less than $25,000 and also a direct contribution to McGill University of $7,500; and McGill University has established the E. B. Eddy chair of industrial and cellulose chemistry, made possible by an endowment in the will of Mrs. Jennie G. H. Shirreff Eddy. Harold Hibbert, D. Sc., Ph.D., who was recently brought from Yale University, and appointed professor of industrial and cellulose chemistry, for this new chair, addressed the convention.

Census Report of Calcium Arsenate Production

The Department of Commerce announces that 19 companies or firms, operating 23 plants, reported, for the year ended June 30, 1925, the production of 19,911,262 lb. of calcium arsenate, 13,865,482 lb. of lead arsenate, and 3,544,887 lb. of Paris green. According to the returns collected at the biennial census for 1923, these 19 companies represented approximately 70 per cent of the total production for that year.

The following statement shows production and sales during the year ended June 30, 1925, stocks on hand at the end of the year, quantity of arsenic consumed during the year and on hand at the end of the year, and amount contracted for for the year ending June 30, 1926:

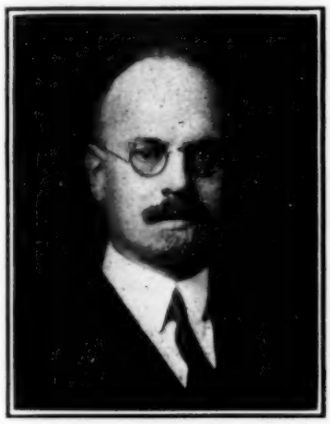
	Production, Lb.	On Hand June 30, 1925, Lb.
Calcium arsenate	19,911,262	15,558,214
Lead arsenate, powder	13,523,902	2,153,553
paste	341,580	36,193
Paris green	3,544,887	2,640,809
Arsenic (99%) prime white), lb:		
Used in the manufacture of—		
Calcium arsenate		7,702,069
Lead arsenate		3,932,644
Paris green		2,441,540
On hand June 30, 1925		2,731,733
Contracted for use during year ending June 30, 1926		3,058,000

Calcium Arsenate		Lead Arsenate		Paris Green	
Size of Container, Lb.	Total Quantity, Lb.	Size of Container, Lb.	Total Quantity, Lb.	Size of Container, Lb.	Total Quantity, Lb.
200	54,200	600	26,400	300	154,600
100	12,273,138	500	500	250	203,500
50	105,550	300	44,700	200	39,400
25	584,840	200	292,500	150	8,700
10	1,660	100	3,208,393	100	375,000
5	64,300	50	58,050	56	35,700
4	78,534	25	782,538	50	100
3	15,111	12½	438	28	145,308
1	23,449	10	119,728	14	392,077
½	7,135	6	603,327	5	164,085
...	.....	5	1,019,348	4	2,647
...	.....	4	6,356,617	4	29,514
...	.....	3	31,246	2	226,496
...	.....	2	14,782	1	606,400
...	.....	1	574,200	½	93,881
...	.....	½	146,433	¼	150,854
...	.....	¼	103	Bbls.	34,361
Total	13,207,917		13,279,303		2,662,623

Men You Should Know About

DR. PARKE REXFORD KOLBE was inaugurated president of Brooklyn Polytechnic Institute on January 13.

DR. EDWARD W. WASHBURN has been chosen to head the Chemical Division of the Bureau of Standards. He succeeds the late Dr. W. F. Hillebrand. Dr. Washburn for a number of years has been editor-in-chief of the International Critical Tables of Physical and Chemical Constants. He will continue this work in connection with his



Edward W. Washburn

new duties. Previous to Dr. Washburn's connection with the National Research Council he was a member of the faculty at the University of Illinois. He has been active in work of the American Ceramic Society and for a time was the editor of its Journal.

F. G. COTTRELL and S. C. LIND of the Fixed Nitrogen Research Laboratory, H. E. Howe, editor of *Industrial and Engineering Chemistry* and H. C. Parmelee, editor of *Chem. & Met.* accompanied Roger Williams, chemical director of Lazote, Inc., on a trip to Charleston, W. Va., on Feb. 6, to inspect the new synthetic ammonia plant of Lazote, Inc., which went into production this month.

H. CLAY HODGSON, formerly superintendent of production of the wood distillation plant of the Thomas Berry Chemical Co., Manistique, Mich., is now on the operating staff of the duPont Rayon Co., at its Old Hickory, Tenn., plant.

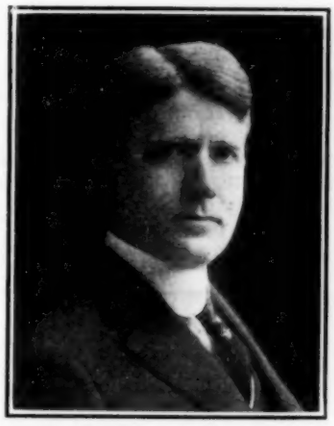
Through a combination of errors the name of G. H. MAINS was not mentioned with that of F. B. LaForge in connection with the furfural exhibit of the Bureau of Chemistry in the Court of Chemical Achievement at the Tenth Exposition of Chemical Industries. Mr. Mains played an important part in the Bureau's work upon the production of furfural and his name should have appeared with that of his associate.

A. W. ALLEN has resigned from the editorial representation of *Chem. & Met.* in the Pacific Coast region to resume active work in the technology of Chilean nitrate. Mr. Allen, who was responsible for the introduction of hydrometallurgical bulk-leaching methods for the treatment of caliche and for the development of a process used by the duPont Nitrate Co. for the beneficiation of discard refractory material, sails for Valparaiso late in February, to join the technical staff of Gibbs & Co.

ISADORE ZELLERBACH, president of the Zellerbach Paper Co. of San Francisco, succeeds Frank M. Newbert as head of the California State Fish & Game Commission. Mr. Zellerbach promises vigorous action in the rigid enforcement of the laws prohibiting pollution, and foretells opposition to the injunction suits recently filed by California canners in an effort to prevent the application of the Reduction Act, passed by the last Legislature, which aims to inhibit the manufacture of fish into fertilizer.

DR. ALBERT F. WOODS, president of the Maryland State University, is to be appointed Director of Scientific Work in the U. S. Department of Agriculture to fill the vacancy caused the resignation of Dr. E. D. Ball.

LOUIS F. VOGT has resigned as works manager of the Standard Chemical Co., producers of radium and alloys of vanadium and uranium, after 13 years of service. He developed many of the processes used by this company, organized and carried on the Canonsburg, Pa., works production from its beginning in 1912. He formerly was



Louis Fenn Vogt

connected with the production of alkali, heavy chemicals generally and vanadium. Beyond retaining some financial and consulting interest in the Standard Chemical Co., he contemplates activity in other lines.

R. L. HOLLIDAY, formerly design engineer for the duPont Co. for 10 years, having had charge of design on plants manufacturing acids, heavy chemicals, artificial leather and a varied line of work of this nature, is now chief engineer of the Spray Dryer Process Corp., New York City.

DR. ROBERT J. ANDERSON, consulting metallurgical engineer, has just been appointed district manager of R. J. Ryan and Co., industrial heating engineers of Philadelphia, Pa., representing them in Cleveland and surrounding territory.

JOHN F. JOSEPH, for 28 years with the B. F. Goodrich Co., Akron, O., and recently superintendent in charge of the mechanical goods and hard rubber depts. has become vice-president of the Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.

DR. PAUL B. DUNBAR, who has been associated with the Bureau of Chem-

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Dr. Paul B. Dunbar

istry since 1907 in scientific and administrative work in connection with the enforcement of the food and drug act, has been appointed assistant chief of the Bureau.

CLIFFORD B. BELLIS until recently consulting metallurgist in Boston is now connected with the Bristol Co., as engineer in the laboratory of the service department.

CLYDE E. WILLIAMS, formerly of the Bureau of Mines, is now with the Columbia Steel Corp., in the San Francisco office.

DR. T. FUJIHARA is now with the Carnegie Steel Co. in Pittsburgh, in the experimental engineering department of the Duquesne works of the company.

KARL B. THEWS, formerly plant manager for the Keystone Metals Reduction Co., is now vice-president and general manager of the Pittsburgh Lacquer and Chemical Co. and secretary and treasurer for the American Chemical Co. Mr. Thews' office is in the Farmers Bank Bldg., Pittsburgh, Pa.

JÜRI ANNUSSON, professor of chemistry at the Technical College, Tallinn-Reval, Esthonia, returned home in January, after spending several months in the United States studying educational methods.

DR. COLIN G. FINK delivered the January lecture of the John Howard Appleton series at the Metcalf Laboratory of Brown University on "Electrolytic Restoration of Ancient Bronzes" covering the research that he and

Charles H. Eldridge have been carrying out at Columbia University in conjunction with the Metropolitan Museum of Art of New York.

THORNE L. WHEELER, formerly of Wheeler & Woodruff, has joined the organization of Arthur D. Little, Inc. Dr. A. W. Francis and Dr. Christian V. Holland have also joined that organization.

PROF. ALFRED H. WHITE, head of the chemical engineering department at the University of Michigan and Mrs. White sailed for Europe, Feb. 13. Prof. W. L. Badger will take Prof. White's place during his absence.

ARTHUR W. GRAY has resigned as director of physical research of the L. D. Caulk Co., Milford, Del., to become physicist of the Calco Chemical Co., Bound Brook, N. J.

WILLIAM SEGUINE, JR., formerly sales engineer for Filtration Engineers, Inc., has left for Oakland, California, as metallurgist for the Glidden Co.

EDWARD A. BARNES, formerly of the California Cap Co., has joined the D. V. O. Products, Inc., of Modesto, Calif., manufacturers of barium products, compounds and allied chemical products.

ROGER C. WILLIAMS, formerly with Merck and Co., and for the past three years in the employ of Van Dyke & Co., has resigned from the latter firm to join the technical staff of the Royal Baking Powder Co.

PROF. MARSTON T. BOGERT of the Department of Organic Chemistry at Columbia University, under the authority of the Secretary of War and at the request of Major General Amos A. Fries, Chief of the Chemical Warfare Service, has been appointed a research consultant of the latter service to assist in the solution of problems with the investigations and developments under way in the C. W. S. Prof. Bogert has also been elected chairman of the Section of Chemistry of the National Academy of Sciences for the period 1926-29 in succession to Prof. Wilder D. Bancroft of Cornell.

EGBERT MOXHAM, formerly director, vice-president and general manager for the Aetna Exp'osives Co., and president and director of the Federal Container Co., Philadelphia, Pa., has been made a partner in the firm of Shields & Co., New York.

H. C. O. CLARK, formerly with the U. S. Bureau of Mines, has been appointed director in charge of a special department formed by the Pure Oil Co., to handle all petroleum engineering and technical work for its production department. He will also act as head of the eastern division. W. W. Scott and R. B. Kelly, both likewise previously with the Bureau of Mines, will be in charge of the work of the new department in the southwestern division and Texas division, respectively.

H. K. HITCHCOCK, consulting engineer for the Pittsburgh Plate Glass Co., Pittsburgh, Pa., sailed recently for a trip to the West Indies, accompanying Capt. C. W. Brown, president of the company. They will return about the middle of March.

E. S. FARISH, head of the Humble Oil Co., Houston, Tex., has been elected president of the American Petroleum Institute, succeeding J. Edgar Pugh.

R. L. CLARE, of the Federal Terra Cotta Co., Woodbridge, N. J., has been elected president of the American Ceramic Society for the coming year.

THOMAS BUXTON, formerly Canadian manager for the British Dyestuffs Corp., is now with the National Aniline and Chemical Co., Ltd., Toronto, Ont., Canada.

HAROLD M. EASTMAN, formerly chemist for the Opson Co., Lockport, N. Y., has joined the staff of the Paper Makers Chemical Co., at the Holyoke, Mass., plant. The company is the largest manufacturer of rosin size in the world and also deals in chemicals used in the paper industry. Mr. Eastman will be active in a considerable extension of the present laboratory where some of the vital research problems of the industry will be attacked.

WILLIAM H. KOBBÉ, whose work during the past few years in connection with the development of new uses of sulphur has brought him into close contact with the chemical industries has recently been placed on a consulting basis. Continuing a connection with the Texas Gulf Sulphur Co., Mr. Kobbé's consulting activities will be devoted exclusively to sulphur and its products.

Obituary

AUGUST KLIPSTEIN, founder of the firm of A. Klipstein and Co., N. Y., manufacturers and distributing agents of dyes, chemicals, varnish gums and tanner's supplies, died at his home in New York on Jan. 8, at the age of 77. Mr. Klipstein was born in Germany and his activities in the dyestuff and chemical industries of the U. S. extended over a period of more than 50 years. He came to America in 1871. His widow, two sons and a daughter survive.

EDWARD E. ARNOLD, president of Arnold, Hoffman & Co., Inc., died at his home at Providence, R. I., Dec. 15. He was seventy-two years old. He was president of the Castner Electrolytic Alkali Co. of Niagara Falls, president of Nitrogen Products Co., president of Oneonta Light and Power Co., president of Pawtuxet Valley Water Co., director of Ponemah Mills and director of Industrial Trust Co.

DR. KARL GOLDSCHMIDT, head of Th. Goldschmidt, A.G., of Essen, Germany, died on Jan. 4, following an operation from which he failed to rally. Dr. Goldschmidt was approaching his seventieth year. He was one of the founders and original directors of the Goldschmidt Detinning Co., now the Metal and Thermit Corp., of New York. Dr. Theodore Goldschmidt succeeds his father as active head of the German firm.

WILLIAM J. RICH, 66 years old, principal examiner of the division of electrochemistry and metallurgy, United States Patent Office, for the last 25 years and long prominent in Odd Fellows and Masonic circles in the District of Columbia, died at George Washington University Hospital recently. He had been in the employ of the Patent Office for 38 years, going there as an assistant examiner.

A. WILLARD CASE, an early founder of the paper industry in Connecticut, died at his home in Manchester, Conn., Dec. 21, at the age of 85. Until his death Mr. Case was actively engaged in business and secretary of Case Brothers, Inc. He was also president of the Case Mfg. Co. and the A. Willard Case Co. of Unionville, and a director of the Case & Marshall Co., Burnside.

HERBERT B. POTTER, managing director of the Wingate Chemical Co., Montreal, and secretary-treasurer of the Mallinckrodt Chemical Works, Ltd., died at his home in Montreal recently in his 61st year.

EARL CAREY, chemist, particularly prominent in the wood-chemical branch of the industry for more than 20 years past, died at his home in Hancock, N. Y., Feb. 1, aged 48 years. Mr. Carey had but recently purchased the plant of the Luzerne Chemical Co., Long Eddy, N. Y.

NATHANIEL T. BACON, for many years associated with the Solvay Process Co., Syracuse, N. Y., died Jan. 3, at the age of 67.

ANDRE RIBAUD, assistant to Prof. M. Claude of Paris, died recently as a result of an explosion in a laboratory in which he was working. A large portion of the Ribaud researches have been devoted to the extraction from the atmosphere of rare gases, such as kryton and xenon. He was 25 years of age.

J. OLIVER STOKES, president of the Thermoid Rubber Co., Trenton, N. J., and treasurer of the Joseph Stokes Rubber Co., of the same city, died Jan. 24, at his home at Pasadena, Calif.

Calendar

AMERICAN CHEMICAL SOCIETY, 71st meeting, Tulsa, Okla., April 5 to 9, 1926.

AMERICAN MANAGEMENT ASSN., Hotel Astor, N. Y., March 3, 4 and 5.

AMERICAN ELECTROCHEMICAL SOCIETY, Chicago Beach Hotel, Chicago, April 22, 23 and 24, 1926.

AMERICAN INSTITUTE OF CHEMICAL ENGRS., Berlin, N. H., June 21-24, 1926.

CANADIAN CONVENTION OF CHEMISTS, under the joint auspices of the Society of Chemical Industry and the Canadian Institute of Chemistry, Montreal, May 31, June 1 and 2.

CHEMICAL EQUIPMENT ASSOCIATION, Exposition, Cleveland, week of May 10, 1926.

COLLOID SYMPOSIUM (Fourth Annual), Mass. Inst. of Tech., Cambridge, Mass., June 23 to 25.

SESQUI-CENTENNIAL INTERNATIONAL EXPOSITION, Independence Sq., Philadelphia, Pa., June 1 to Dec. 1.

SOUTHERN EXPOSITION (2nd Annual), Madison Sq. Garden, N. Y., Oct. 2-10.

Large Gain in Production of Denatured Alcohol in Fiscal Year

Anti-Freeze Requirements for 1925-1926 Season Were Estimated at 36,850,057 Gal. or 45 per Cent of Total Output

A SUMMARY of the alcohol industry in this country has just been issued by the Commissioner of Internal Revenue. The summary is in tabular form and goes into figures of production, withdrawals from bond, denaturing, etc. The period covered in the fiscal year ended June 30, 1925. Production of ethyl alcohol is placed at 87,455,535 wine gal., 190 proof and the amount withdrawn from bond in the year was 85,352,703 wine gal. Of the amount withdrawn from bond 78,078,210 wine gal. or 91.56 per cent of total withdrawals, was destined for denaturing plants.

Louisiana maintained its position as the leading producing state with a total output of 31,718,955 wine gal. or 36.27 per cent of the entire production. Maryland which is the second ranking state showed a loss in operations as compared with the preceding fiscal year but produced 16,234,355 wine gal. or 18.56 per cent of the total. Pennsylvania held the third position with an output of 10,327,892 wine gal. or 11.81 per cent of production. California and other western states produced only 5,927,707 wine gal. Production of ethyl alcohol for the last 6 fiscal years compares as follows:

PRODUCTION OF ETHYL ALCOHOL

	Wine Gal.	Index
1925	87,455,535	170
1924	71,525,118	138
1923	64,422,552	125
1922	42,033,842	82
1921	44,773,040	86
1920	51,808,610	100

The amount of ethyl alcohol denatured in the last fiscal year was 78,078,210 wine gal. which was increased 4.89 per cent in volume in denaturing so that the total amount of denatured alcohol available was 81,808,273 wine gal. The latter amount was made up of 46,983,969 wine gal. completely denatured and 34,824,303 wine gal. specially denatured. While there was a larger production of specially denatured as compared with the preceding fiscal year, the gain was not commensurate with the gain in total production and a larger proportionate share went into the completely denatured. Annual production of denatured alcohol for the last 6 fiscal years was as follows:

PRODUCTION OF DENATURED ALCOHOL

	Completely Denatured Wine Gal.	Specially Denatured Wine Gal.
1925	46,983,969	34,824,303
1924	34,602,003	33,085,292
1923	27,128,229	30,436,913
1922	16,193,523	17,152,224
1921	12,392,592	9,996,229
1920	13,528,402	15,307,947

In the completely denatured formula No. 5 predominated and was followed in denaturing 36,079,786 wine gal. of ethyl alcohol. Formula No. 6 was used in denaturing 8,738,097 wine gal. and all other formulas entered into the denaturing of 1,595,426 wine gal. The completely denatured was largely authorized for use as an anti-freeze and for general purposes.

Formulas for specially denaturing are much more numerous than those for completely denaturing and more of them were employed in the denaturing process. The authorized use of the specially denatured product also was of wider scope and more specifically defined as is shown in the following table:

DISTRIBUTION OF SPECIALLY DENATURED ALCOHOL

Formula	Authorized Use	Gals. Used 1925	Gals. Used 1924
S.D. 39b	Perfumes and toilet lotions	7,588,363	7,356,764
S.D. 1	Shellac varnish and gen. manufacturing	7,165,124	7,067,676
S.D. 2b	Pyroxylin — nitrocellulose	6,722,979	5,242,882
S.D. 39a	Barber supply preparations	1,565,101	2,085,013
S.D. 13a	Sulphuric ether	1,260,420	1,902,536
S.D. 40	Perfumes and high-grade toilet preparations	2,714,025	1,817,191
S.D. 18	Acetate lime—vinegar	1,306,809	1,716,283
S.D. 3a	Shampoo jellies and transparent soap	728,975	811,295
S.D. 4	Tobacco products	1,036,796	779,274
S.D. 35a	Pectin	310,468	749,607
S.D. 23a	Lotions and liniments	503,689	460,015
All other (69 formulae)	Various uses	3,879,409a	3,018,480
	Total	34,782,158	33,007,016

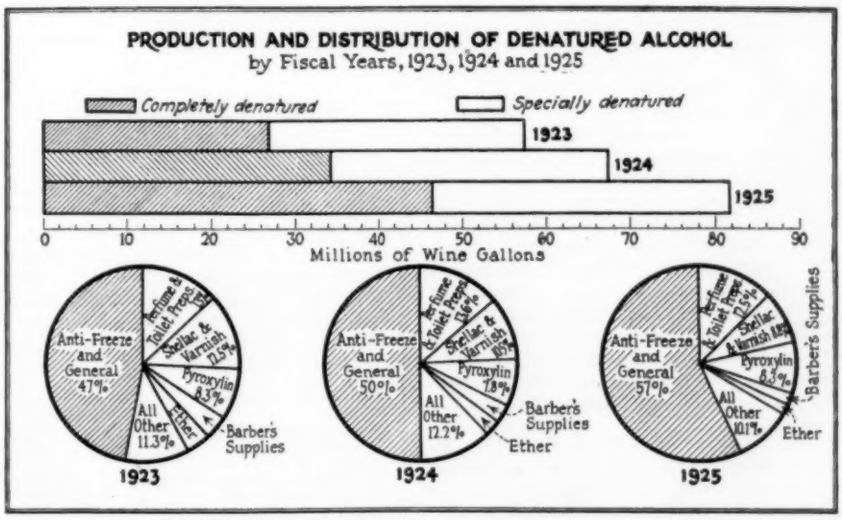
As the largest individual use of denatured alcohol is for anti-freeze purposes in the automotive industries, it was but natural for producers to look for a larger outlet in that field in the present fiscal year. This opinion was based on the record production and sales of automobiles during the year. John J. Carroll of the Kentucky Alcohol Corporation using the "use and requirement" factor adopted by the Internal Revenue Bureau in 1924, prepared an estimate of the anti-freeze alcohol which would be required to take care of consuming requirements in the 1925-1926 winter season. His computations were further based on a registration of 20,200,349 cars and trucks and his deduction was that 36,850,057 gal. would be consumed for anti-freeze purposes. In the light of recent developments this estimate may appear too high as weather conditions in some parts of the country have not been conducive to a normal use of anti-freeze preparations and the use of competing materials has gained headway. At any rate the market at present is depressed by large surplus stocks of alcohol as may be readily seen from the fact that denatured alcohol has been quoted as low as 36c. per gal. The geographical distribution of completely denatured alcohol shows that a relatively high percentage of the total is used in the middle western states. The specially denatured product, however, finds its greatest outlet in New York and adjoining sections.

The steady increase in production and consumption of alcohol in recent years naturally has been reflected in an increased call for raw materials. For instance the amount of molasses consumed in the manufacture of alcohol in 1922 was 89,114,070 gal. More than twice that amount went into the alcohol industry in 1925, the total being reported at 187,397,844 gal. These figures refer to alcohol production in states east of the Rocky Mountains and while not complete they cover the major part of production in that section of the country.

The following figures indicate the amount of molasses used in alcohol production in the last 2 fiscal years, details being given for the various states:

MOLASSES USED IN ALCOHOL PRODUCTION

	1925 Gal.	1924 Gal.	1923 Gal.
Louisiana	86,323,250	64,211,803	63,080,217
Maryland	47,544,844	43,342,084	41,049,579
Pennsylvania	25,417,623	19,510,311	17,047,859
Massachusetts	8,890,582	6,096,424	6,142,365
Illinois	3,940,129	3,084,699	5,584,538
Ohio	406,962	2,410,695	4,635,497
New York	12,995,265	9,848,613	2,798,083
Indiana	.....	466,425	754,871
New Jersey	266,770	139,666	622,446
Kentucky	995,081	.....	492,045
West Virginia	464,134	645,750	22,077
Missouri	110,095	14,220	.....
Wisconsin	43,109	.....	.....
	187,397,844	149,770,690	142,229,577



Market Conditions and Price Trends

Active Call for Chemicals Indicated For First Quarter of Year

Large Contract Placements and General Business Conditions Favor Heavy Consumption of Chemical Products

CONTRACT deliveries of chemicals are reported to have been going forward in a large way since the first of the year. The volume of contract business in the latter part of 1925 was large and this in itself is indicative of an active delivery period in the first part of this year. As an index of what may be expected in the way of movement of raw materials and finished products in the first quarter, it is noteworthy the buyers and sellers of transportation in the eastern territory held a meeting on Jan. 14 and reports from forty industries indicated an expected increase of 10 per cent in business for the quarter. The report on the paint, oil, and varnish industries expressed the opinion that 1926 would be one of the largest years in the history of those industries. The survey of the fertilizer trade finds that outward shipments for the coming quarter will require 13,463 cars for transportation. This means a slight gain in distribution over the first quarter of 1925. No change is expected in the shipments of cotton yarns, woolens, suitings and overcoatings, oil cloths and linoleums, carpets, and Rayon silk; a 10 per cent increase is looked for in cotton piece goods, felts and pile fabrics; a 12 per cent decrease is looked for in bleached goods; and a 2 per cent increase is looked for in the shipment of natural silk.

Gains in Employment

With detailed information at hand regarding employment during December, it becomes apparent that operations in the chemical industry and in those lines, which are large consumers of chemicals, were maintained on an active scale. A slight reduction is indicated in the dyeing and finishing of textiles, in the leather industry and in the manufacture of glass. With these exceptions activities were on a higher basis than in November and the comparison with December, 1924, is still more favorable as every industry enumerated shows a material gain over the corresponding period of 1924. A report from the leather trade says that in the aggregate tanners' stocks were lower on December 1 than at the commencement of the preceding month. The decrease in welting leather was 200,000 pounds and in upholstery leather about 19,000 hides and pieces. Stocks in process of manufacture at the end of December were also lower. The decrease was in the upholstery and welting leather departments of the trade.

The Bureau of Labor statistics on employment, reduced to an index in which the monthly average in 1923 is taken as 100, offers the following comparisons for employment in the chemical consuming industries:

INDEX OF EMPLOYMENT

	Dec. 1925	Nov. 1925	Dec. 1924
Dyeing and finishing textiles	100.8	101.2	98.6
Leather	91.2	91.4	90.4
Paper and pulp	94.8	94.5	92.6
Chemicals	96.1	95.8	91.7
Fertilizers	101.6	101.1	88.1
Glass	98.6	99.3	89.1
Automobile tires	110.7	107.0	102.9
Petroleum refining	99.1	98.6	89.2

AVERAGE INDEX OF EMPLOYMENT

	1925	1924
Dyeing and finishing textiles	98.9	91.2
Leather	90.3	88.1
Paper and pulp	94.4	93.9
Chemicals	92.7	91.0
Fertilizers	98.8	84.6
Glass	93.3	89.3
Automobile tires	112.2	96.9
Petroleum refining	94.3	92.1

The figures as set forth above for average index of employment merely represent the averages for the index numbers in the different industries as reported for the separate months of the year. These indexes should afford a fairly accurate basis for comparison of activities in the trades enumerated. The comparison is entirely in favor of 1925 and offers proof of the expansion in production and consumption of chemicals last year.

Manufacturing production in December equaled November production in total, but the average per working day, at 123 per cent of the 1919 average, showed a decline of 4 per cent, according to the index number of the Department of Commerce. Industrial output was, however, 10 per cent higher than in December, 1924. Production for 1925, as a whole stood, at 126 per cent of the 1919 average, the largest recorded and 11 per cent above the 1924 level.

All industrial groups showed increased output in 1925 over 1924, except foodstuffs, the largest relative gains occurring in iron and steel, lumber, stone and clay products, chemicals and oils and automobiles. Comparing December with November, the leather and foodstuffs groups made the largest gains while the lumber, stone and clay products, tobacco and miscellaneous groups, the last named including automobiles, declined. All groups showed higher output than in December, 1924, except stone and clay products.

The output of raw material was 3 per cent less in December than in November and declined 2 per cent for the year as a whole. The production of minerals and of forest products increased in 1925 over 1924 and crop and animal marketings declined, while December results were higher than a year ago for crops and forest products, but lower for minerals and animal products.

Stocks of commodities held at the end of December showed an increase of 8 per cent over November, when allowance is made for seasonal variations, and increased 3 per cent over a year ago. All groups except manufactured commodities increased over November, while compared with a year ago, foodstuffs, both raw and manufactured, increased, while the other groups declined. For the year as a whole, average stocks were higher than in 1924 for all groups except manufactured foodstuffs.

Lower Price Levels

While there are reports of price cutting in some chemicals, trading in the majority of heavy chemicals is on a steady basis with values at well established levels. The weighted index during the past month was lower with the irregularity of alcohol prices as a main contributing factor. Lower prices also were in effect for February deliveries of tin salts and for some of the miscellaneous chemical items. The weighted member now stands at 112.32 as compared with 113.86 a month ago and 113.66 a year ago.

The weighted index number for oils and fats showed a material decline during the month. The number is now 149.34 in comparison with 154.79 a month ago and 148.33 a year ago. In analyzing the drop in the index number it is found that most selections of the group were on a downward price trend. Cottonseed oil did not change materially but values seem none too well established in view of the large seed supply. Linseed oil prospects have changed completely with the record seed crop of the Argentine and still lower prices may be expected. Coconut, china wood, castor, and palm oils also have been working lower and the same is true of tallow, greases, and stearines.

Imports of Coal-Tar Dyes in January

Imports of coal-tar dyes for the month of January, 1926, by ports are as follows:

	Lb.	Invoice Value
New York	179,985	$177,319
Boston	10,474	6,699
Total	190,459	$184,018

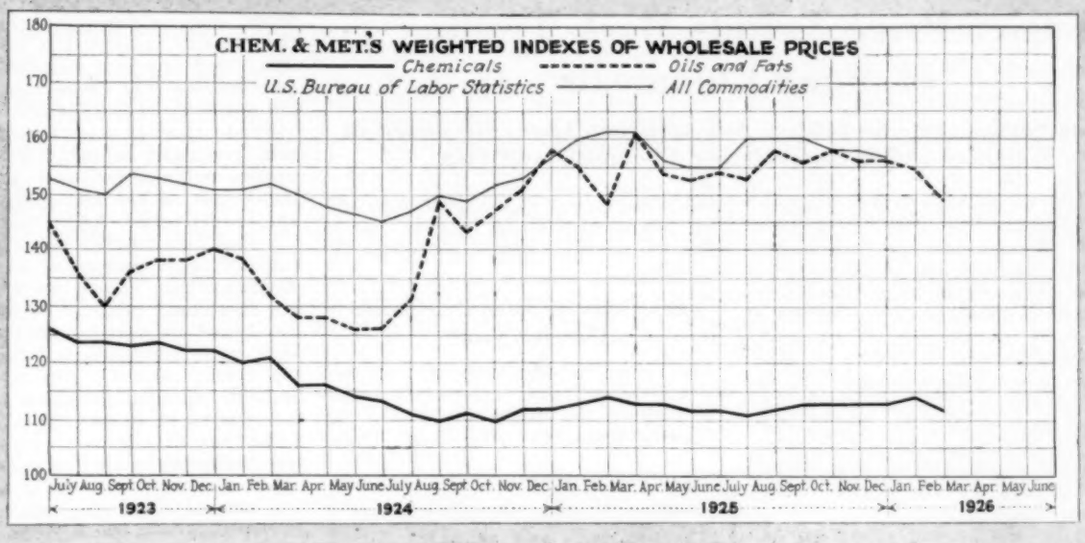
The January total for dyes does not include the warehouse withdrawals for the Port of New York, details for which will be in the February import list. As the withdrawals comprise a considerable portion of the totals, the figures for January are below the actual imports for that month.

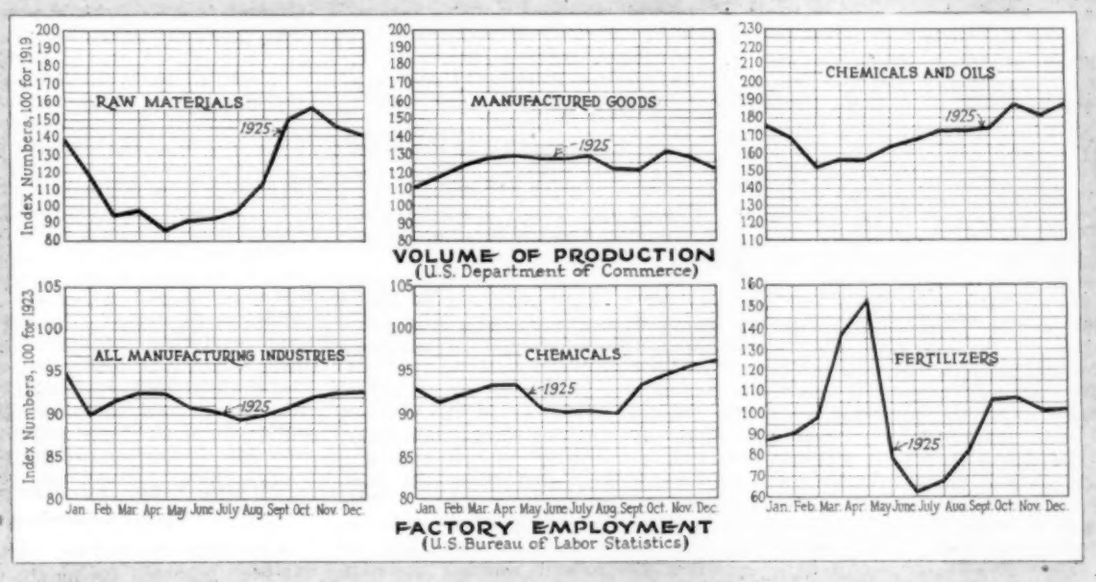
Leading Dyes Imported in January:

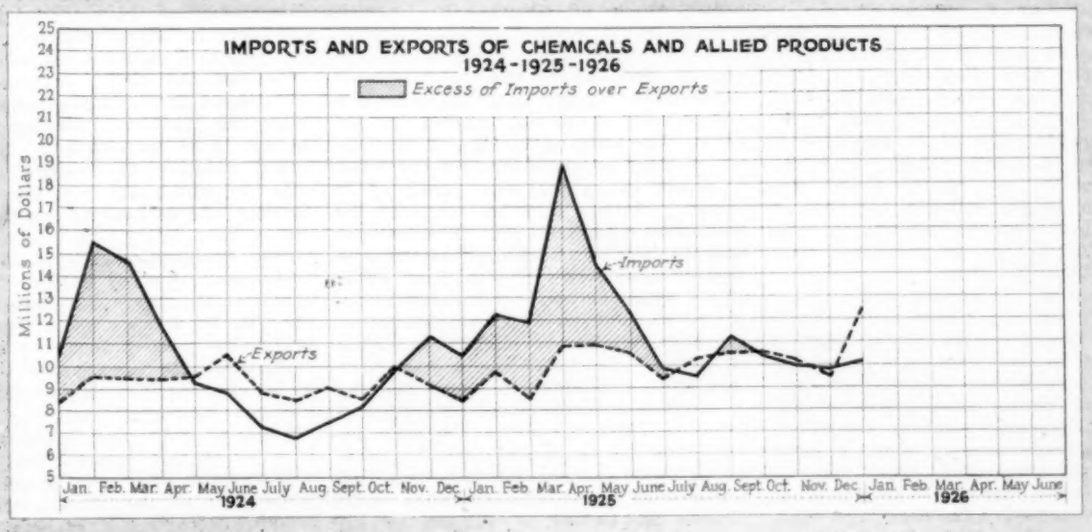
	Lb.
Ciba violet R (single strength)	17,630
Ciba scarlets (single strength)	15,285
Cross dye green B, 2G	8,838
Helindone red 3B (single strength)	6,133
Trisulphon brown GS	5,004

Chem. & Met.'s *Statistics of Business*

In The Chemical Engineering Industries







Market Conditions and Price Trends

Easier Price Trends Mark Trading in Many Chemicals

Surplus Stocks and Competitive Selling Bring About Recession in Weighted Index Numbers for Chemicals and Oils

BUYING of chemicals for new account has not been very heavy since the first of the year although the movement against outstanding contracts has been satisfactory. The market has been featured by an easier price tone, in some cases expressed in open price reductions and in others by private concessions without any declared change in the prevailing quotation. Selling pressure usually has been found to rest on desire to reduce surplus stocks and it seems evident that there is an oversupply of some chemicals in the present market.

Alcohol is one of the selections in which selling competition has been very keen and market values have fallen steadily under the weight of offerings. Consumption in some lines has not come up to expectations and with production going ahead at a rapid pace, surplus stocks began to accumulate in an alarming way and the law of supply and demand became all important as a price factor. It is difficult to determine whether the situation is more than temporary but low prices undoubtedly will continue until weak holdings have been taken from the market. Carbon tetrachloride has been in a keenly competitive market and values have eased off accordingly. Caustic soda which has sold at irregular prices for export has been somewhat unsettled by reports that the quotation price has not been maintained in making sales to the domestic trade. The tin salts were marked down in price for February delivery but this was the usual monthly price regulation based on the cost of the metal. Most selections of the vegetable oil group have gone down in price with further recessions predicted for some items.

The strong situation which prevailed in the market for glycerine has been fairly well maintained. Predictions of further drastic rises in price, however, were not fulfilled and in the closing trading the trend appeared to be toward a lower range of prices. The effect of the higher prices was sent in a larger call for the foreign product last year as imports in 1925 were 21,292,301 lb. as compared with 15,927,701 lb. in 1924.

Members of the arsenic and calcium arsenate trades have been interested in a report issued by the Department of Commerce to the effect that more cotton boll weevils are hibernating than during any Winter since 1915 and that unless unfavorable weather conditions for the weevils develop soon, a more severe infestation than usual may be expected next Spring. At Tallulah, La., where records have been kept since 1915, the number of live weevils found per ton of Spanish moss, a favorite hibernating place of the pest was 280. This compared with 16 in 1924, 229 in 1923, 137 in 1917, 133 in 1916 and 737 in 1915.

Variations in Sales Prices for Caustic Soda

Last year, particularly in the hot weather period, some sellers of chemicals adopted the expedient of offering attractive prices for the export trade in order to ship surplus stocks out of the country. This served the two-fold purpose of reducing large carryovers and of permitting intensive selling pressure without disturbing the equilibrium of domestic markets. With the publication of detailed statistics for the export trade of December, the question has arisen whether distributors of caustic soda have followed this precedent in an attempt to improve the statistical position of the market.

In the first place exports in that month were 11,998,182 lb. which is considerably larger than the total for any of the preceding months of the year. The striking feature of the official returns is found in the large total, 5,289,539 lb., which was consigned to Japan. Mexico received 2,128,696 lb. and Cuba 19,938,621 lb. The balance was distributed in smaller amounts to various countries. The invoiced value of the goods shipped to Japan was reported as $102,680 which represents an average price per lb. slightly in excess of 1.94c. As f.a.s. quotations have been given at 2.80c. to 3.10c. per lb., it becomes evident that the indicated price on Japanese shipments may account for the large amount of caustic which was shipped to that country. Exports to Spain in December were 448,000 lb. valued at $12,096 or an average value of 2.70c. per lb. Outward shipments to other countries, and these account for more than one-half the export movement in December, were well up to quotation levels and demonstrate that there was no general let down in export prices.

Production of caustic soda in 1925 was estimated at 492,000 tons. Producers entered the new year with a large part of the 1926 output sold for future delivery. Additional buying in the last two months has not been especially large and there have been indications that stocks were accumulating in sellers' hands. Such deductions are based on reports that sales have been made for domestic deliveries under the openly quoted figure of 3.10c. per lb. For instance a western soap maker is reported to have bought 15 cars at 2.80c. per lb. Reports of shading in the dealer trade also have been prevalent. Nor are such sales excused on the ground that they were made by electrolytic makers who had accumulated caustic soda in maintaining supplies of chlorine necessary to fill existing orders as the initiative in low priced sales for caustic is said to have been taken by producers who do not operate under the electrolytic process.

Some idea of the competition in foreign consuming markets which confronted domestic sellers last year may be gained from a recent report stating that Italian importations of caustic soda during the first eight months of 1925 were 15,804 metric tons compared with 10,151 and 14,898 metric tons during the parallel period of 1924 and 1923 respectively. French caustic soda dominated the Italian market in 1925, due to the low prices offered by the French Solvay concern, which in the latter part of November were equivalent to $2.61 per 100 lb. delivered duty paid to any part of Italy.

Strong Tone To Market for Liquid Chlorine

A growing demand for liquid chlorine has been reported during the past year. In great part this has been due to a substitution of this material for bleaching powder. Paper makers, especially, are reported to have shown a preference for the liquid chlorine with a corresponding diminution of interest in bleaching powder. During the past month, however, reports have been heard relative to enlarged calls for chlorine which are not the result of further encroachments in the bleaching powder field.

One explanation offered is that the restoration of ethyl gasoline to a valid commercial status has again opened the way for a wide use of bromine. It is further stated that the extraction of bromine from sea water was proved to be commercially practicable by operations conducted last Spring. The process of extraction requires the use of chlorine and demand for the latter will increase in volume in more or less proportion to the extent with which bromine extraction is carried out. Other new outlets for chlorine are said to have been developed recently.

Leading Market Developments During the Month

Barium carbonate will be investigated as a result of petitions for a higher import duty.

Investigation showed that there was no dumping of potash alum or zinc chloride from Germany.

Large surplus stocks of denatured alcohol have weakened values and prices have dropped materially.

Caustic soda market is disturbed by reports that domestic sales are made under the quotation price.

German producers of oxalic acid are reported to have attempted to form combinations with domestic producers.

Market Conditions and Price Trends

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.32**
Last month	113.86
February, 1925	113.66
February, 1924	121.05

The large supplies of alcohol on hand brought out selling pressure and this was the most prominent factor in lowering the weighted index number. An easy tone was manifest in many chemicals but actual changes in price were few in number.

Nothing has been made public in the way of defining these new consuming outlets but some members of the trade have admitted that experimental work has been done in that direction and with results that may be termed successful. At any rate it is evident that there is some foundation for the belief that consumption of liquid chlorine will reach record proportions during the present year.

The question of enlarged demand directs attention to the probable supply. By the electrolytic process of manufacture an increase in the output of chlorine would mean a larger supply of caustic soda. While it is stated that some of the new outlets for chlorine also would offer a larger distribution of caustic soda, it is hardly probable that an even level could be maintained and it is possible that manufacturers may be faced with the dilemma of enlarging chlorine production at the expense of caustic soda values or of limiting chlorine production in order to stabilize the caustic market. In either event a strong price tendency should rule with changes in quotations favoring sellers. The market at present is described as firm and if consuming demand shows the gains which seem to be expected upward revisions in price would be probable.

Agreements Figure in Market for Oxalic Acid

Interest has been attracted to the market for oxalic acid by reports that domestic interests either had applied, or would apply, for an increase in the import duty on calcium oxalate. The Tariff Commission has made no announcement on this subject and it is difficult to secure confirmation or denial of the reports. Rumor credits such action on the part of domestic producers of oxalic acid to a desire to increase the laid down cost of German calcium oxalate to a point where it will be unprofitable for new producers of acid to enter the field with the German oxalate as their raw material.

Back of all this are reports of an attempt to form a working agreement between domestic and German producers of oxalic acid. These reports in substance are: Representatives of German producers made advances to domestic makers of the acid whereby the former would cease to offer competition in this acid in domestic markets on condition that the latter would buy their calcium oxalate from Germany. The calcium oxalate was offered at a price slightly in excess of 4c. per lb. One domestic manufacturer favored the proposition and a round lot shipment of oxalate was made from Germany. The manufacturer in question found that oxalic acid made from this oxalate cost about 3c. per lb. more than the current market quotation for the acid and this terminated his interest in the proposed agreement. The application for higher duty on the oxalate then came into the story as a logical means to thwart attempts of the German interests to induce new factors to undertake the manufacture of this acid.

Production of oxalic acid in this country in 1922 was 3,978,807 lb. and imports were 2,621,302 lb. Since 1922 no figures for domestic production have been issued but the home output declined in 1923 and showed gains in 1924 and 1925. There has been but slight changes in domestic consumption in recent years and average consuming requirements are placed at approximately 6,000,000 lb. As imports in 1925 were 2,590,149 lb. domestic production for that year would figure out around 3,600,000 lb. with due allowance for the carry over of stocks. There has been no change in market values during the month, the inside quotation for foreign and domestic acid being maintained at 10¾c. per lb. In view of current reports in the market it would appear that selling competition would continue, but trade opinions incline to a belief that present values will be maintained and that future price changes will be upward.

Competition Weakens Values for Carbon Tetrachloride

An analysis of figures for domestic production and sales of carbon tetrachloride shows that in recent years there has been a large surplus of stocks with a consequent increase in selling activities and a lowering in market values. Official figures for 1925 are not yet available but production and sales for the three preceding years were as follows:

	Production Lb.	Sales Lb.
1924	14,275,057	11,698,694
1923	13,513,644	11,007,361
1922	11,166,318	9,231,824

In 1922 the average price of sales was 8c. per lb. and this average was maintained in 1923, but in 1924 the figure had declined to 7c. per lb. Evidently supply has held its position over demand as sellers have been unusually active since the turn of the year. The open quotation for this material in drums is 6¼c. per lb. but reports credit some sellers with offering freely on a basis of 5c. per lb. in tanks.

Investigation of Import Duties Ordered

Investigations of the duty on fluorspar and on barium carbonate have been ordered by the U. S. Tariff Commission.

The action with regard to fluorspar was taken on applications submitted by the Lundgren-Stevens Company, of Chicago, and James A. Green, of Cincinnati, who ask for a revision upward of the existing rates. This is necessary they say to remedy the very unsatisfactory condition of the domestic industry.

Revision upward also is desired in the barium application which has been filed by the Bertha Chemical Company, of Newark, N. J.; the Barium Reduction Company, of New York, and the Chicago Copper and Chemical Company.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**149.34**
Last month	154.79
February, 1925	148.33
February, 1924	131.71

A sharp decline in the weighted index number followed the lower prices established for linseed, coconut, castor, and palm oils. Tallow and some of the animal oils also contributed to the downward movement.

Imports of Chemicals

	Dec. 1925	Dec. 1924
Dead or creosote oil, gal.	4,274,998	6,897,321
Naphthalene, lb.	.....	351,241
Pyridine, lb.	69,596	77,962
Arsenic, lb.	470,410	652,341
Acid, citric, lb.	11,200	56,000
Acid, formic, lb.	87,486	174,237
Acid, oxalic, lb.	85,267	492,245
Acid, sulphuric, lb.	3,858,131	652,000
Acid, tartaric, lb.	16,576	268,800
Ammonia chloride, lb.	1,003,587	1,348,911
Ammonia nitrate, lb.	1,179,776	56,543
Barium compounds, lb.	1,486,496	491,436
Calcium carbide, lb.	2,739,965	1,363,600
Copper sulphate, lb.	336,126	182,937
Bleaching powder, lb.	94,047	127,206
Potassium cyanide, lb.	203,747	169,938
Potassium carbonate, lb.	618,929	759,237
Potassium hydroxide, lb.	881,409	1,148,577
Potassium chlorate, lb.	156,911	676,831
Sodium cyanide, lb.	2,338,735	2,287,524
Sodium ferrocyanide, lb.	260,350	173,139
Sodium nitrite, lb.	781,620	270,651
Sodium, nitrate, ton	43,018	59,300
Sulphate of ammonia, ton	2,197	774

Exports of Chemicals

	Dec. 1925	Dec. 1924
Benzol, lb.	6,006,330	7,914
Aniline oil and salt, lb.	75,728	165,642
Acid, acetic, lb.	41,010	85,072
Acid, boric, lb.	41,519	99,793
Acid, sulphuric, lb.	581,442	948,326
Methanol, gal.	73,092	35,310
Aluminum sulphate, lb.	4,133,056	2,589,600
Acetate of lime, lb.	2,969,651	980,145
Calcium carbide, lb.	173,365	410,557
Bleaching powder, lb.	1,693,944	1,690,223
Copper sulphate, lb.	1,605,782	433,841
Formaldehyde, lb.	493,127	335,660
Potassium, bichromate, lb.	41,107	70,257
Sodium, bichromate, lb.	963,739	.....
Borax, lb.	2,946,577	3,007,431
Soda ash, lb.	2,935,510	1,626,516
Sodium silicate, lb.	3,995,227	2,212,653
Sal soda, lb.	838,258	638,691
Caustic soda, lb.	11,998,182	8,619,679
Sulphate of ammonia, ton	12,413	6,166

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to February 15.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.12 -$0.13	$0.12 -$0.13	$0.10 -$0.11
Acid, acetic, 28%, bbl.	cwt.	3.25 - 3.50	3.25 - 3.50	3.12 - 3.37
Boric, bbl.	lb.	.08½- .10	.08½- .10	.09 - .09½
Citric, kegs	lb.	.45½- .47	.45½- .47	.45½- .47
Formic, bbl.	lb.	.10 - .11½	.10 - .11	.10½- .10¾
Gallic, tech., bbl.	lb.	.45 - .50	.45 - .50	.45½- .47
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06½- .07
Lactic, 44%, tech., light, bbl.	lb.	.11½- .12	.11½- .12	.13½- .14
22%, tech., light, bbl.	lb.	.05½- .06	.05½- .06	.06½- .07
Muriatic, 18°, tanks	cwt.	.80 - .85	.80 - .85	.80 - .85
Nitric, 36°, carboys	cwt.	.05 - .05½	.05 - .05½	.04 - .04½
Oleum, tanks, wks.	ton	17.50 -20.00	17.50 -20.00	16.00- 17.00
Oxalic, crystals, bbl.	lb.	.10½- .11	.10½- .11	.10½- .11
Phosphoric, tech., c'bys.	lb.	.07 - .07½	.07 - .07½	.07½- .08
Sulphuric, 60°, tanks	ton	8.50 - 9.50	8.50 - 9.50	8.00 - 9.00
Tannic, tech., bbl.	lb.	.35 - .40	.35 - .40	.45 - .50
Tartaric, powd., bbl.	lb.	.27½- .30	.27½- .30	.27 - .29
Tungstic, bbl.	lb.	1.00 - 1.20	1.00 - 1.20	1.20 - 1.25
Alcohol, ethyl, 190 p'f. U.S.P. bbl.	gal.	4.94 - 5.04	4.94 - 5.04	4.89 -
Alcohol, Butyl, dr.	lb.	.19 - .20	.20 - .21	.27 - .30
Denatured, 190 proof No. 1 special dr.	gal.	.36 -	.54½-	.55 -
No. 5, 188 proof, dr.	gal.	.36 -	.53½-	.54 -
Alum, ammonia, lump, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl.	lb.	.05½- .05¾	.05½- .05¾	.05½- .06
Potash, lump, bbl.	lb.	.02¼- .03¼	.02¼- .03¼	.02¼- .03¼
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg.	cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums.	lb.	.03½- .04	.03 - .04	.06½- .06¾
Ammonia, anhydrous, cyl.	lb.	.13 - .15	.13 - .15	.28 - .30
Ammonium carbonate, powd. tech., casks.	lb.	.08½- .10	.08½- .10	.12½- .12¾
Nitrate, tech., casks	lb.	.08 - .08½	.08 - .08½	.09 - .10
Sulphate, wks.	cwt.	2.90 -	2.95 -	2.75 -
Amylacetate tech., drums.	gal.	2.35 - 2.50	2.35 - 2.50	3.25 - 3.50
Antimony Oxide, bbl.	lb.	.18½- .19	.18½- .19	.16 - .16½
Arsenic, white, powd., bbl.	lb.	.03½- .04½	.03½- .04½	.05½- .05½
Red, powd., kegs.	lb.	.12 - .12½	.12½- .13	.14½- .15½
Barium carbonate, bbl.	ton	43.00 -45.00	45.00 -54.00	54.00 -58.00
Chloride, bbl.	ton	58.00 -60.00	60.00 -62.00	66.00 -68.00
Nitrate, cask.	lb.	.08 - .08½	.07½ - .07¾	.07½- .08
Blanc fixe, dry, bbl.	lb.	.03¾- .04	.03¼- .04	.03¾- .04
Bleaching powder, f.o.b., wks., drums.	cwt.	2.00 - 2.10	2.00 - 2.10	1.90 -
Borax, bbl.	lb.	.05 - .05½	.05 - .05½	.05 - .05¾
Bromine, cs.	lb.	.45 - .47	.45 - .47	.47 - .48
Calcium acetate, bags	cwt.	3.25 - 3.50	3.25 - 3.50	3.00 - 3.05
Arsenate, dr.	lb.	.07 - .08	.07 - .08	.08 - .09
Carbide drums	lb.	.05½- .06	.05½- .06	.05 - .05½
Chloride, fused, dr., wks.	ton	21.00 -	21.00 -	21.00 -
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.06½- .07½
Carbon bisulphide, drums	lb.	.06 - .06	.06 - .06½	.06 - .06½
Tetrachloride drums	lb.	.06½- .06¾	.07 - .07½	.07 - .07½
Chlorine, liquid, tanks, wks.	lb.	.04 - .04	.04 - .04½	.04½-
Cylinders	lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans	lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	13.50 -11.00	13.50- 14.00	16.00 -18.00
Copper carbonate, bbl.	lb.	.17 - .18	.17 - .18	.17½- .17¾
Cyanide, tech., bbl.	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	4.50 - 4.60	4.50 - 4.60	4.50 - 4.65
Cream of tartar, bbl.	lb.	.21 - .22	.21 - .22	.20½- .21
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags.	cwt.	1.30 - 1.40	1.30 - 1.40	1.35 - 1.40
Ethyl acetate, 85% drums.	gal.	.80 - 82.	.82 - .85	.92 - .95
99%, dr.	gal.	1.03 -	1.05 -	1.08 - 1.10
Formaldehyde, 40%, bbl.	lb.	.09 - .09½	.09 - .09½	.09 - .09½
Furfural, dr.	lb.	.17½-	.17½-	.23 -
Fusel oil, crude, drums.	gal.	1.80 - 1.90	1.80 - 1.90	2.60 - 2.80
Refined, dr.	gal.	3.10 - 3.20	3.10 - 3.20	4.00 - 4.50
Glauber's salt, bags.	cwt.	1.15 - 1.25	1.15 - 1.25	1.20 - 1.40
Glycerine, c.p., drums, extra.	lb.	.25 - .26	.25 - .26	.19 - .19½
Lead: White, basic carbonate, dry, casks	lb.	.10½-	.10½-	.11½-
White, basic sulphate, sck.	lb.	.10 -	.10 -	.11 -
Red, dry, sck.	lb.	.12½-	.12½-	.13½-
Lead acetate, white crys., bbl.	lb.	.14½- .15	.14½- .15	.15½-
Lead arsenate, powd., bbl.	lb.	.14½- .15	.13 - .14	.16 - .18
Lime, chem., bulk	ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk.	lb.	.11½-	.11½-	.12½-
Lithopone, bags.	lb.	.05½- .06	.06 - .06½	.06 - .06½
Magnesium carb., tech., bags.	lb.	.06½- .07	.06½- .07	.07 - .08
Methanol, 95%, dr.	gal.	.57 - .62	.57 - .62	.70 - .72
97%, dr.	gal.	.59 - .64	.59 - .64	.72 - .74
Nickel salt, double, bbl.	lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl.	lb.	.10½- .11	.10½- .11	.10 - .11
Orange mineral, csk.	lb.	.14 -	.14 -	.16½-
Phosphorus, red, cases	lb.	.68 - .70	.70 - .75	.70 - .75
Yellow, cases	lb.	.34 - .36	.34 - .36	.37½- .40
Potassium bichromate, casks.	lb.	.08½- .08¾	.08½- .08¾	.08½- .08¾
Carbonate, 80-85%, calc., csk.	lb	.06 -	.06 -	.06 - .06½
Chlorate, powd.	lb.	.08½- .09	.08½- .09	.07 - .08
Cyanide, cs.	lb.	.52 - .54	.55 - .58	.47 - .62
First sorts, csk.	lb.	$0.08½-$0.09	$0.08½-$0.09	$0.08½-$0.08¾
Hydroxide(c'stic potash) dr.	lb.	.07½- .07¾	.07½- .07¾	.07½- .07¾
Muriate, 80% bgs.	ton	34.90 -	34.90 -	34.55 -
Nitrate, bbl.	lb.	.06½- .06¾	.06½- .06¾	.06 - .07½
Permanganate, drums	lb.	.14½- .15	.14½- .15	.14½- .15
Prussiate, yellow, casks	lb.	.18½- .18¾	.18½- .18¾	.18½- .18¾
Sal ammoniac, white, casks.	lb.	.05½- .06	.06 - .07	.06 - .06½
Salsoda, bbl.	cwt.	1.10 - 1.30	1.20 - 1.40	1.20 - 1.40
Salt cake, bulk	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.38 -	1.38 -	1.38 -
Dense, bags.	cwt.	1.45 - 1.55	1.45 - 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.10 -	3.10 -	3.10 -
Acetate, works, bbl.	lb.	.04½- .05	.04½- .05	.05 - .05½
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	1.75 - 2.00
Bichromate, casks	lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Bisulphate, bulk	ton	5.00 - 5.50	4.50 - 5.00	6.00 - 7.00
Bisulphite, bbl.	lb.	.03½- .04	.03½- .04	.04½- .04¾
Chlorate, kegs	lb.	.06½- .06¾	.06½- .06¾	.06½- .07
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.08½- .09	.08½- .09	.09 - .09½
Hyposulphite, bbl.	lb.	.01½- .02¼	.01½- .02¼	.02½- .02¾
Nitrate, bags.	cwt.	2.71 -	2.63 -	2.42½-
Nitrite, casks.	lb.	.09½- .09¾	.09½- .09¾	.09 - .09½
Phosphate, dibasic, bbl.	lb.	.03¼- .03¾	.03¼- .03¾	.03½- .03¾
Prussiate, yel. drums.	lb.	.10 - .10½	.10 - .10½	.10½- .10¾
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03 - .03½	.03 - .03½	.02½- .03
Sulphite, crys., bbl.	lb.	.03 - .03¼	.02½- .03	.02½- .03
Strontium nitrate, bbl.	lb.	.09 - .10	.09 - .10	.09½- .10
Sulphur, crude at mine, bulk	ton	17.00 -	17.00 -	14.00 -16.00
Chloride, dr.	lb.	.05 - .05½	.04½- .05	.04½- .05
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.08½- .09
Flour, bag	cwt.	2.70 - 3.00	2.35 - 2.80	2.25 - 2.35
Tin bichloride, bbl.	lb.	.17 -	.17½-	.16 -
Oxide, bbl.	lb.	.64 -	.66 -	.61 -
Crystals, bbl.	lb.	.41½-	.43 -	.39½-
Zinc chloride, gran., bbl.	lb.	.07 - .07½	.07½- .08	.06 - .07½
Carbonate, bbl.	lb.	.10½- .11	.10½- .11	.12 - .14
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.09 - .10	.10 - .10½	.08 - .08½
Zinc oxide, lead free, bag.	lb.	.07½-	.07½-	.07½-
5% lead sulphate, bags.	lb.	.07 -	.07 -	.06½-
Sulphate, bbl.	cwt.	3.00 - 3.50	3.00 - 3.50	3.50 - 3.75

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.14½-$0.15	$0.15 -$0.15½	$0.17 -$0.17½
Chinawood oil, bbl.	lb.	.13 - .13½	.13 - .13½	.14½- .15
Coconut oil, Ceylon, tanks, N. Y.	lb.	.10½-	.11½-	.09¼-
Corn oil crude, tanks, (f.o.b. mill)	lb.	.09½-	.09½-	.09½-
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½-	.09½-	.08½-
Linseed oil, raw, car lots, bbl.	lb.	11.2 -	11.8 -	15.3 -
Palm, Lagos, casks	lb.	.09 -	.09½-	.09½-
Niger, casks	lb.	.08½-	.08½-	.08½-
Palm Kernel, bbl.	lb.	.10 - .10½	.11 - .11½	.09½-
Peanut oil, crude, tanks(mill)	lb.	.10 -	.10 -	.11 -
Perilla, bbl.	lb.	.15 -	.15 - .15½	.14½-
Rapeseed oil, refined, bbl.	gal.	.93 - .92	.93 - .94	.90 - .91
Sesame, bbl.	lb.	.15 - .15½	.15 - .15½	.15 - .15½
Soya bean tank (f.o.b. Coast)	lb.	.10½-	.10½-	.11 -
Sulphur(olive foots), bbl.	lb.	.08½-	.08½-	.09½-
Cod, Newfoundland, bbl.	gal.	.64 - .66	.64 - .66	.62 - .63
Menhaden, light pressed, bbl.	gal.	.69 - .71	.72 - .74	.72 - .75
Crude, tanks(f.o.b. factory)	gal.	.55 -	.55 -	.55 - .58
Whale, crude, tanks	lb.	-	-	-
Grease, yellow, loose	lb.	.08½-	.09 -	.08½-
Oleo stearine	lb.	.11½- .12	.12½- .13	.10½-
Red oil, distilled, d.p. bbl.	lb.	.11 - .11½	.11½- .11¾	.10½- .11½
Tallow, extra, loose	lb.	.09½-	.09½-	.09 -

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl.	lb.	.90 - .95	.90 - .95	.75 - .80
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.16 - .16½	.17 - .17½	.16 - .16½
Aniline salts, bbl.	lb.	.20 - .22	.20 - .22	.20 - .21
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.65 - .70
Benzaldehyde, U.S.P., dr.	lb.	1.15 - 1.20	1.15 - 1.20	1.50 -
Benzidine base, bbl.	lb.	.72 - .74	.72 - .75	.78 - .82
Benzoic acid, U.S.P., kgs.	lb.	.56 - .60	.60 - .62	.75 - .85
Benzyl chloride, tech, dr.	lb.	.25 - .26	.25 - .26	.35 - .36
Benzol, 90%, tanks, works.	gal.	.23 - .28	.23 - .28	.23 - .28
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.24 - .25
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.23 - .25
Cresylic acid, 97%, dr., wks.	gal.	.53 - .55	.53 - .55	.59 - .62
Diethylaniline, dr.	lb.	.55 - .60	.55 - .57	.59 - .61
Dinitrophenol, bbl.	lb.	.30 - .33	.30 - .33	.35 - .38
Dinitrotoluen, bbl.	lb.	.15 - .17	.16 - .17	.18 - .20
Dip oil, 25% dr.	gal.	.28 - .30	.28 - .30	.26 - .28
Diphenylamine, bbl.	lb.	.48 - .50	.48 - .50	.48 - .50
H-acid, bbl.	lb.	.68 - .72	.68 - .72	.70 - .74

Coal-Tar Products—Continued

		Current Price	Last Month	Last Year
Naphthalene, flake, bbl.	lb.	$0.07 -$0.07½	$0.05 -$0.05½	$0.05 -$0.05½
Nitrobenzene, dr.	lb.	.09½- .10	.09½- .10	.09 - .10
Para-nitraniline, bbl.	lb.	.51 - .53	.53 - .54	.65 - .67
Para-nitrotoluine, bbl.	lb.	.30 - .35	.35 - .36	.40 - .42
Phenol, U.S.P., drums	lb.	.22 - .24	.22 - .24	.23 - .25
Picric acid, bbl.	lb.	.25 - .26	.25 - .26	.20 - .22
Pyridine, dr.	lb.	4.80 - 5.00	4.15 - 4.25	4.10 - 4.20
R-salt, bbl.	lb.	.40 - .44	.40 - .44	.50 - .55
Resorcinal, tech, kegs	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl.	lb.	.33 - .34	.33 - .34	.32 - .33
Solvent naphtha, w.w.,tanks	gal.	.35 -	.35 -	.24 - .25
Tolidine, bbl.	lb.	.90 - .95	.95 - .96	1.00- 1.05
Toluene, tanks, works	gal.	.35 -	.35 -	.26 -
Xylene, com., tanks	gal.	.36 - .41	.31 - .36	.24 - .26

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$22.00-$24.00	$17.00-$17.50	$17.00-$17.50
Casein, tech., bbl.	lb.	.13½- .14	.13 - .13½	.13 - .14
China clay, powd., f.o.b. Ga.	ton	10.00 -20.00	12.00 -15.00	12.00 -15.00
Imported, powd.	ton	45.00 -50.00	45.00 -50.00	45.00 -50.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.08 - .08½	.08 - .08½	.06½- .08
Prussian blue, bbl.	lb.	.33 - .34	.34 - .36	.35 - .37
Ultramine blue, bbl.	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.30 - .32	.28 - .30	.30 - .32
Carmine red, tins	lb.	5.10 - 5.25	5.00 - 5.10	4.25 - 4.50
Para toner	lb.	.90 - .95	.90 - .95	.95 - 1.00
Vermilion, English, bbl.	lb.	1.45 - 1.50	1.40 - 1.45	1.40 - 1.45
Chrome yellow, C. P., bbl.	lb.	.18 - .18¼	.18 - .18½	.19½- .20
Feldspar No. 1 (f.o.b. N. C.)	ton	6.00 - 6.50	5.50 - 6.00	6.50 - 7.00
Graphite, Ceylon, lump, bbl	lb.	.08½- .09	.08½- .09	.07 - .07½
Gum copal, Congo, bags	lb.	.09½- .10	.09½- .10	.08 - .10
Manila, bags	lb.	.14 - .16	.14 - .16	.14 - .16
Damar, Batavia, cases	lb.	.27 - .27½	.29½- .30	.28½- .28¾
Kauri, No. 1 cases	lb.	.57 - .65	.57 - .65	.58 - .62
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	40.00 -41.00	35.00 -42.00	35.00 -40.00
Pumice stone, lump, bbl.	lb.	.04½- .06	.04½- .08	.05 - .05½
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, B-H	bbl.	13.40 -14.60	14.50 -	8.40 - 8.50
Turpentine	gal.	1.01 -	1.11 -	.94 -
Shellac, orange, fine, bags	lb.	.68 - .69	.72 - .74	.65 - .66
Bleached, bonedry, bags	lb.	.50 - .51	.51 - .52	.73 - .74
T. N. bags	lb.	.40 - .41	.42 - .43	.62 - .63
Soapstone (f.o.b. Vt.), bags	ton	9.00 -10.00	7.00 - 7.50	7.50 - 8.00
Talc, 200 mesh (f.o.b. Vt.)	ton	11.00 -	11.00 -	10.50 -
200 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	8.00 -12.00
325 mesh (f.o.b. N. Y.)	ton	14.75 -	14.75 -	14.75 -
Wax, Bayberry, bbl.	lb.	.20 - .21	.20 - .22	.21 - .21½
Beeswax, ref., light	lb.	.44 - .45	.44 - .45	.38 - .39
Candelilla, bags	lb.	.35 - .36	.32 - .33	.32 - .33
Carnauba, No. 1, bags	lb.	.46 - .47	.48 - .49	.37 - .38
Parafine, crude 105-110 m.p.	lb.	.05½- .06	.06 - .06¼	.06¼-

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-	$200.00-	$200.00-
Ferrochromium, 1-2%	lb.	.23- .35	.23- .35	.24-
Ferromanganese, 78-82%	ton	115.00-	115.00-	115.00-
Spiegeleisen, 19-21%	ton	33.00-34.00	32.00-33.00	32.00-
Ferrosilicon, 10-12%	ton	33.00-38.00	33.00-38.00	39.50-43.00
Ferrotungsten, 70-80%	lb.	1.14- 1.20	1.15-	.90-
Ferro-uranium, 35-50%	lb.	4.50-	4.50-	4.50-
Ferrovanadium, 30-40%	lb.	3.25- 4.00	3.25- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.14¼-$0.14½	$0.14¼-$0.14¼	$0.14¼-$0.15¼
Aluminum, 96-99%	lb.	.27 - .28	.28 -	.27 - .28
Antimony, Chin. and Jap.	lb.	.21½- .22	.20 - .20½	.20½-
Nickel, 99%	lb.	.34 -	.34 -	.31 - .32
Monel metal, blocks	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits	lb.	.64¼- 63½	.62½-	.57½-
Lead, New York, spot	lb.	.09¼-	.09¼-	.09½-
Zinc, New York, spot	lb.	.08¼-	.09¼-	.07¼-
Silver, commercial	oz.	.67 -	.70½-	.63¼-
Cadmium	lb.	.60 -	.60 -	.60 -
Bismuth, 508-lb. lots	lb.	2.65 - 2.70	2.65 - 2.70	1.30 - 1.35
Cobalt	lb.	2.50 -	2.50 -	2.50 - 3.00
Magnesium, ingots, 99%	lb.	1.00 -	1.00 -	.90 - .95
Platinum, ref.	oz.	120.00-	120.00-	117.00-
Palladium, ref.	oz.	87.50- 88.00	78.00- 83.00	78.00-
Mercury, flask	75 lb.	91.00-	88.00-	79.00-80.00
Tungsten powder	lb.	1.20-	1.20-	.95- 1.00

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	20.50- 23.50	20.50- 23.50	18.50- 24.00
Coke, fdry., f.o.b. ovens	ton	3.75- 4.25	3.75- 4.25	4.75- 5.00
Fluorspar, gravel, f.o.b. Ill.	ton	16.00- 18.00	16.00- 18.00	17.50- 18.50
Ilmenite, 52% TiO_2, Va.	lb.	.01½-	.01½-	.01½-
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.42 - .44	.42 - .44	.42 - .43
Molybdemite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.65 - .70	.65 - .70	.60- .70
Monazite, 6% of ThO_2	ton	120.00-	120.00-	120.00-
Pyrites, Span. fines, c.i.f.	unit	.12½-	.12½-	.11½- .12
Rutile, 94-96% TiO_2	lb.	.12 - .15	.12 - .15	.12 - .15
Tungsten, scheelite, 60% WO_3 and over	unit	12.50 -13.00	12.50 -13.00	9.50 - 9.75
Vanadium ore, per lb. V_2O_5	lb.	1.00 - 1.25	1.00 - 1.05	1.00 - 1.25
Zircon, 99%	lb.	.03 -	.03 -	.06 - .07

Technical Societies, Trade Associations and Commercial Organizations

This compilation of technical and commercial organizations in the chemical engineering and related fields should prove valuable as a reference directory. An effort has been made in each case to give the name and address of the secretary or other responsible official. Additions or corrections should be sent to the Editor, *Chemical & Metallurgical Engineering*, Tenth Ave. at 36th St., New York City.

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Chemical, Metallurgical & Mining Society of South Africa, Inc. Sec., H. A. G. Jeffreys, Scientific & Technical Club, 100 Fox St., Johannesburg, Transvaal, South Africa.

Chemists' Club. Sec., J. W. H. Randall, 52 E. 41st St., New York.

Chemical Warfare Assn. Sec. Frank B. Gorin, Mills Bldg., Washington, D. C.

Circle of Scientific, Technical & Trade Journalists. Hon Sec., Leon Gaster, 32 Victoria St., Westminster, London, S. W. 1, England.

Clay Products Assn. Sec., George C. D. Lenth, Chamber of Commerce Bldg., Chicago, Ill.

Common Brick Mfrs. Assn. of Amer. Sec., Ralph P. Stoddard, 2121 Guarantee Title Bldg., Cleveland, Ohio.

Compressed Air Society. Sec., C. H. Rohrbach, Room 1506, 90 West St., New York..

Compressed Gas Mfrs. Assn. Sec., John H. Luening, 120 W. 42nd St., New York.

Copper & Brass Research Assn. Sec., George A. Sloan, 25 Broadway, New York.

Cost Assn. of the Paper Industry. Sec.-Treas., Thomas J. Burke, 18 East 41st St., New York.

Deutsche Chem. Ges. Sec., Dr. H. Jost, Sigismundstr, 4, W. 10, Berlin, Germany.

Drop Forge Supply Assn. Pres., Hollinshead N. Taylor, 300 Chestnut St., Philadelphia, Pa.

Eastern Clay Products Assn. Sec., H. T. Shelley, 906 Colonial Trust Bldg., Philadelphia, Pa.

Eastern States Blast Furnace and Coke Oven Assn. Sec., C. R. Meissner, Weirton Steel Co., Weirton, W. Va.

Edible Gelatin Manufacturers of America, Inc. Sec., H. B. Sweatt, 1457 Broadway, New York.

Enameled Sanitary Ware Mfgrs. Assn. Sec., George D. McIlvaine, 909 Oliver Bldg., Pittsburgh, Pa.

Engineering Foundation. Director, Alfred D. Flinn, 29 W. 39th St., New York.

Engineering Inst. of Canada. Sec., R. J. Durley, 176 Mansfield St., Montreal, Que., Canada.

Faraday Society. Sec. F. S. Spiers, 90, Great Russell St., London, W. C. 1, England.

Franklin Inst. of the State of Pa. Sec., Howard McClenahan, 15 South 7th St., Philadelphia, Pa.

Gas Products Assn. Sec and Treas., Charles T. Allen, 140 South Dearborn St., Chicago, Ill.

Glass Container Assn. Sec., R. E. Walker, 22 East 75th St., New York.

Gypsum Industries. Sec.-Treas., H. H. Macdonald, 844 Rush St., Chicago, Ill.

Hawaiian Sugar Planters' Assn., Director, H. P. Agee, P. O. Box 411, Honolulu, Hawaii.

Illuminating Engineering Society. Gen. Sec., L. H. Graves, 29 W. 39th St., New York.

Insecticide & Disinfectant Mfrs. Assn., Inc. Sec., H. W. Cole, Holbrook, Mass.

Institute of Amer. Meat Packers. Exec. Vice-Pres., W. W. Woods, 509 S. Wabash Ave., Chicago, Ill.

Institute of Makers of Explosives. Sec., C. Stewart Comeaux, 103 Park Ave., New York.

Institute of Margarin Manufacturers. Sec., Dr. J. S. Abbott, 1049 Munsey Bldg., Washington, D. C.

Institute of Metals. Sec., G. Shaw Scott, 36 Victoria St., Westminster, London, S. W. 1, England.

Institute of Radio Engineers. Sec., Dr. Alfred N. Goldsmith, 37 West 39th St., New York.

Institution of Engineers & Shipbuilders in Scotland. Sec., Edward H. Parker, Elmbank Crescent, Glasgow, Scotland.

Institution of Mining & Metallurgy. Sec., Charles McDermid, Cleveland House, 225 City Road, London, E. C. 1, England.

Institution of Petroleum Technologists. Sec., Commander R. E. Stokes-Rees, Aldine House, Bedford St., Strand, London, W. C. 2, England.

Instituto Cientifico e Industrial del Salitre. Gen. Sec., Belisario Diaz Ossa, Casilla 2730, Santiago, Chile.

International Acetylene Assn., Sec., A. Cressy Morrison, 30 E. 42nd St., New York, N. Y.

Interstate Cotton Seed Crushers' Assn., Inc. Sec., Geo. H. Bennett, 201 N. Texas Bldg., Dallas, Tex.

Inventors' League of the U. S., President, Geo. Whigelt, 114 Maiden Lane, New York.

Iron & Steel Institute. Sec., G. C. Lloyd, 28 Victoria St., London, S. W. 1, England.

Junior Institution of Engineers. Sec., Herbert G. Riddle, 39 Victoria St., Westminster, S. W. 1, England.

Manufacturing Chemists Assoc. of the U. S. Sec., J. I. Tierney, 614 Investment Bldg., Washington, D. C.

Metric Assn. Sec., Howard Richards, 156 5th Ave., New York.

Mining & Metallurgical Soc. of Amer. Sec., Donald M. Liddell, 2 Rector St., New York.

Mirror Mfrs. Assn. Sec., H. C. Sorden, Shelbyville, Ind.

National Academy of Sciences. Sec., Dr. David White, National Academy of Sciences, 21 and B Sts., Washington, D. C.

National Assn. of Cost Accountants. Sec., Stuart C. McLeod, 130 W. 42nd St., New York.

National Assn. of Cotton Mfrs. Acting Sec., Russell T. Fisher, 80 Federal St., Boston, Mass.

National Assn. of Glue Mfrs. Inc., Sec., H. B. Sweatt, 1457 Broadway, New York.

National Association of Importers of Hides & Skins, Inc. Exec. Sec., John R. Arnold, 15 Park Row, New York.

National Assn. of Leather Belting Mfrs. Sec., George H. Blake, P. O. Box 859, City Hall Sta., New York.

National Assn. of Mfrs. of Pressed & Blown Glassware. Sec., John Kunzler, House Bldg., Pittsburgh, Pa.

National Assn. of Mfrs. Sec., George S. Boudinot, 50 Church St., New York.

National Assn. of Practical Refrigerating Engrs. Sec., E. H. Fox, 5707 West Lake St., Chicago, Ill.

National Assn. of Purchasing Agents. Sec., W. L. Chandler, Woolworth Bldg., New York.

National Assn. of Sheet & Tin Plate Mfrs. Sec.-Treas., Walter W. Lower, 421 Oliver Bldg., Pittsburgh, Pa.

National Assn. of Textile Dyers & Finishers. Sec., Arthur Goosetrey, Keene, N. H.

National Brick Manufacturers' Assn. Sec., Theodore A. Randall, 211 Hudson St., Indianapolis, Ind.

National Canners' Assn. Sec., Frank E. Gorrell, 1739 H Street, N.W., Washington, D. C.

National Coal Assn. Exec. Sec., H. L. Gandy, 801 Southern Bldg., Washington, D. C.

National Conference of Business Paper Editors. Sec., Douglas G. Woolf, *Textile World*, 334 Fourth Ave., New York.

National Elec. Light Assn. Exec. Mgr., M. H. Aylesworth, 29 W. 39th St., New York.

National Fertilizer Assn. Exec. Sec., Charles J. Brand, 616 Investment Bldg., Washington, D. C.

National Fire Protection Assn. Sec., Franklin H. Wentworth, 40 Central St., Boston, Mass.

National Foreign Trade Council. Sec., O. K. Davis, 1 Hanover Sq., New York.

National Industrial Conference Board. Sec., James M. Robertson, 247 Park Ave., New York.

National Industrial Council. Sec. and Treas., Earl Constantine, 50 Church St., New York.

National Lime Assn. Gen. Mgr., Burton A. Ford, 918 G St., N.W., Washington, D. C.

National Lumber Manufacturers Assn. Sec., Wilson Compton, Transportation Bldg., Washington, D. C.

National Metal Trades Assn. Sec., J. E. Nyhan, 122 So. Michigan Ave., Chicago, Ill.

National Paint, Oil & Varnish Assn. Sec., G. V. Horgan, 18 East 41st St., New York.

National Paving Brick Mfrs. Assn. Sec., Edward E. Duff, Jr., Engineers Bldg., Cleveland, Ohio.

National Petroleum Assn. Counsel, Mr. Fayette B. Dow, 930 Munsey Bldg., Washington, D. C.

National Petroleum Marketers Assn. Sec., Miss Eva Arnstein, 624 S. Michigan Ave., Chicago, Ill.

National Pipe & Supplies Assn. Sec., Geo. D. McIlvaine, 908 Oliver Bldg., Pittsburgh, Pa.

National Research Council. Sec., Dr. Vernon Kellogg, B and 21st Sts., Washington, D. C.

National Safety Council. Sec., W. H. Cameron, 108 East Ohio St., Chicago, Ill.

National Varnish Mfrs. Assn. Sec., G. B. Heckel, 509 The Bourse, Philadelphia, Pa.

National Wood Chemical Assn. Sec.-Treas., F. J. Goodfellow, 76 Main St., Bradford, Pa.

Natural Gas Assn. of America. Sec., Guy F. Batchelor, 904 Oliver Bldg., Pittsburgh, Pa.

New Jersey Chemical Society. Sec., Dr. Frederick W. Zons, 367 High St., Newark, N. J.

New Jersey Clay Workers Assn. Sec., G. H. Brown, Ceramics Dept., Rutgers College, New Brunswick, N. J.

New York Academy of Sciences. Sec., Dr. Ralph W. Tower, 77th St. and Central Park West, New York City.

Oil & Colour Chemists' Assn. Sec., James H. Aiken, 30 Russell Sq., London, W.C.1, England.

Paint Mfrs.' Assn. of the U. S. Sec., G. B. Heckel, 509 The Bourse, Philadelphia, Pa.

Plate Glass Mfrs. of Amer. Sec., P. A. Hughes, First National Bank Bldg., Pittsburgh, Pa.

Portland Cement Assn. Sec.-Gen. Mgr., William M. Kinney, 111 W. Washington St., Chicago, Ill.

Rubber Assn. of America. A. L. Viles, Gen. Mgr. and Sec., 250 West 57th St., New York.

Rubber Growers' Assn., Inc. Frank S. Smith, Sec., 2, 3 and 4 Idol Lane, Eastcheap, London, E.C. 3, England.

Salesmen's Assn. of the American Chemical Industry. Sec., A. J. Binder, c/o Sherwin-Williams Co., 115 Broadway, New York.

Salt Producers Assn. Sec., D. B. Doremus, 1150 Penobscot Bldg., Detroit, Mich.

Sand-Lime Brick Assn. Sec., G. W. Phelps, Flint, Mich.

Société de Chimie Industrielle. Sec., Jean Gerard, 49 Rue des Mathurins, Paris, France.

Société d'encouragement pour l'industrie Nationale. Sec., M. Henri Hitier, 44 Rue de Rennes, Paris, France.

Société Francaise de Tubize, Grand Quevilly, France.

Society of Chemical Industry. Sec., J. P. Longstaff, 46 Finsbury Sq., London, E.C. 2, England.

Society of Chemical Industry (American Section). Sec., Foster D. Snell, Pratt Institute, Brooklyn, N. Y.

Society of Dyers & Colourists. Sec., J. B. Atkinson, Pearl Assurance Bldgs., Market St., Bradford, England.

Society of Glass Technology. Sec., Prof. W. E. S. Turner, Darnall Road, Sheffield, England.

Society of Industrial Engrs. Exec. Sec., George C. Dent, 608 S. Dearborn St., Chicago, Ill.

Society of Leather Trades Chemists. Sec., W. R. Atkin, University, Leeds, England.

Society for the Promotion of Engineering Education. Sec., Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

South African Chemical Institute. Sec., James Gray, Scientific & Technical Club, 100 Fox St., Johannesburg, So. Africa.

South African Institution of Engrs., Inc. Sec., W. W. R. Jago, Box 4609, Johannesburg, So. Africa.

Steel Barrel Mfrs. Institute. Sec., D. S. Hunter, 809 Bulkley Bldg., Cleveland, Ohio.

Structural Steel Society. Sec.-Treas. Chas. O. Baughman, Morava Construction Co., 8457 Stewart Ave., Chicago, Ill.

Sugar Producers' Conference. Sec., E. W. Mayo, 135 Front St., New York.

Synthetic Organic Chem. Mfrs. Assn. of the U. S. President, Dr. Chas. H. Herty, Room 343, 1 Madison Ave., New York.

Tanners' Council. Ass't Sec., J. L. Nelson, 41 Park Row, New York.

Taylor Society. Managing Director, Harlow S. Person, 29 W. 39th St., New York.

Technical Assn. of the Pulp & Paper Industry. Sec., W. G. MacNaughton, 18 E. 41st St., New York.

Technical Publicity Assn. Sec., W. C. Cash, Ingersoll-Rand Co., New York.

Textile Alliance. Pres., A. M. Patterson, 45 E. 17th St., New York.

Turpentine and Rosin Producers Assn. Sec., C. F. Speh, Whitney-Central Bldg., New Orleans, La.

Union Internationale de la Chimie Pure et Applique. Sec., Jean Gerard, 49 Rue des Mathurins, Paris, France.

United Engineering Society. Sec., Alfred D. Flinn, 29 W. 39th St., New York.

U. S. Paint & Varnish Mfrs. Assn. Sec., Dr. H. A. Gardner, 2201 New York Ave., N. W., Washington, D. C.

U. S. Potters Assn. Sec., Charles F. Goodwin, East Liverpool, Ohio.

U. S. Pulp Producers Assn. Sec., Oliver M. Porter, 18 E. 41st St., New York.

U. S. Sugar Manufacturers Assn. Sec., Harry A. Austin, 901 Union Trust Bldg., Washington, D. C.

Washington Academy of Science. Sec., F. B. Silsbee, Bureau of Standards, Washington, D. C.

Western Petroleum Refiners Assn. Managing Director, Howard Bennette, 504 Cosden Bldg., Tulsa, Okla.

Industrial Notes

Newell, Corse and McDaniel, 706 Otis Bldg., Washington, D. C., announce the continuation of their consulting engineering business under that name. A Latin American department has been established under the direction of Dr. Richard Muller, to handle hydroelectrical developments, irrigation, drainage, water supply and other utility projects. The Research Service, Inc., will be operated by this company, and will continue to handle matters pertaining to Washington representation, surveys, investigations, and reports for business, industry and trade associations.

The Celite Products Co. has moved its San Francisco office to 140 Spear Street.

Canadian Canners, Ltd., has transferred its research laboratory from Brighton to Hamilton, Ont. H. W. Powell is chief chemist.

Braeburn Alloy Steel Co. has opened a Cleveland office at 310 Union Mortgage Bldg., under the direction of A. G. Cappel, and has moved its Pittsburgh office to the First National Bank Bldg.

The Lee B. Mettler Co., Los Angeles, Calif., manufacturers of the Mettler entrained combustion gas burners, has appointed the Automatic Safety Appliance Corp., 53 Park Pl., New York, as its representative in the states of New York, New Jersey, Eastern Pennsylvania and the New England states.

The Diamond State Fibre Co., Bridgeport, Pa., has appointed C. M. Bogert district manager for the state of Connecticut, with offices at South Norwalk, Conn., and W. R. Eisenhans, formerly of the Bridgeport home office, as district manager at Philadelphia, with offices at 822 Drexel Bldg.

Henry Disston & Sons, Inc., of Philadelphia, announce the appointment of E. A. C. Baum as assistant Western representative for steel sales, with headquarters at 111 North Jefferson Street, Chicago.

The Sheet Aluminum Rolling Mill of the Sheet Aluminum Corp. of Jackson, Michigan, has commenced operations producing a full line of aluminum sheets. The general sales offices are in the Ford Building, Detroit, with W. J. Moore, vice-president, in charge of sales. Mr. Moore is also president of the Allied Metal Products Corp. of Detroit.

The Griscom-Russell Co. has moved its general offices to 285 Madison Ave., New York, N. Y.

The Diamond Power Specialty Corp. of Detroit, Mich., announces the appointment of M. J. Miller as sales engineer in charge of the Detroit district.

The Foxboro Co., Inc., of Foxboro, Mass., has moved its Pittsburgh office to the Foxboro Bldg., Sixth Avenue and Grant Street.

Fuller-Lehigh Co., Fullerton, Pa., now manufactures and sells the Fuller-Bonnot unit mill.

The Pennsylvania Crushers Co. has moved its general offices to the 19th floor of the new Liberty Trust Bldg., Philadelphia, Pa.

The Maxim Silencer Co., Hartford, Conn., manufacturer of silencers for industrial machinery, has appointed W. O. Whitney as sales manager.

The Earle Gear and Machine Co., Philadelphia, announces the sale and transfer of all designs, patterns, patents and good will covering Earle centrifugal pumps to the Aldrich Pump Co., 1 Pine St., Allentown, Pa., who will continue the manufacture and marketing of same. This does not affect the Earle company's other products.

The Barber Asphalt Company of Philadelphia has taken over the exclusive rights to manufacture "Aterite," a non-corrosive, acid-resisting metallic alloy from the Aterite Company, Inc., New York City, and is in a position to furnish "Aterite" valves, fittings and special castings which will be manufactured at the Iroquois plant at Buffalo, N. Y.

The Link-Belt Co. of Chicago has appointed W. W. Sayers chief engineer, and George L. Morehead manager of the Philadelphia plant.

The Oxweld Acetylene Co. of New York, has appointed J. N. Walker general sales manager.

The Driver-Harris Co. of Harrison, N. J., has appointed Frederick V. Lindsey sales manager of resistance materials. Mr. Lindsey has been identified with the manufacture of nickel and nickel alloys for a number of years, being vice-president and secretary of the Electrical Alloy Co. previous to its purchase by Driver-Harris Co. His efforts will be concentrated in his new appointment on the manufacture and sale of Nichrome for industrial and domestic applications.

The Glascote Co. has appointed Alan K. Gillespie and Fred B. Morris factory representatives with offices at 4030 Chouteau Avenue, St. Louis, Mo.

The Bridgeport Brass Co., Bridgeport, Conn., has appointed H. A. Watkins metropolitan district sales manager with offices in the Pershing Square Bldg., New York City.

Hills-McCanna Co., Chicago, has opened an office in the East with A. B. Harrison in charge. Until such time as a permanent office is located he can be reached at 24 East 23rd Street, Chester, Pa.

Philadelphia Quartz Co., Philadelphia, plans the erection of a plant in St. Louis, Mo., located on Geraldine Ave.

The Abbott Laboratories, North Chicago, Ill., announce that Floyd K. Thayer, who has been with them for five and one-half years in the capacity of research chemist, has been placed in charge of the chemical sales department, and also of the newly-organized industrial sales division of the company.

Current Industrial Developments

New Construction and Machinery Requirements

New England

Conn., Oakdale — Massasoit Mfg. Co. awarded contract for the construction of a 1 story, 20 x 65 ft. chlorinating plant including two tanks for settling and mixing, to Oliver Woodworth Co., 36 Pearl St., New London. Estimated cost $20,000.

Mass., Somerville (Boston P. O.)—Boston & Maine R.R., North Station, Boston, plans the construction of a coke reclamation plant. Estimated cost $40,000. F. A. Merrill, is chief engineer.

Middle Atlantic

N. J., Newark—Keystone Varnish Co., 71 Otsego St., Brooklyn, N. Y., will soon award contract for the construction of a 3 story, 60 x 220 ft. factory on Railroad Ave., here. Estimated cost $300,000. Fletcher-Thompson Co., 350 Madison Ave., New York, N. Y., is architect and engineer.

N. J., Trenton—Essex Rubber Co., C. H. Oakley, Pres., Beakes and May Sts., plans to rebuild finishing and inspecting departments, machine shop, etc., to replace fire loss. Estimated cost $200,000. Machinery will be required.

N. Y., Buffalo—Bronze Aluminum Co., 212 Winchester Ave., is in the market for small tools and equipment for the manufacture of aluminum ware.

N. Y., Buffalo—Buffalo Slag Co., Ellicott Square Bldg., plans the construction of a cement plant. Estimated cost $2,000,000. Owner also plans construction of cement plants in Cleveland and Chicago, estimated cost, $2,000,000 each.

N. Y., Long Island City—Hygrade Corrugated Paper Products Co., H. Kooner, Pres., Manley St., plans the construction of a paper plant at Hunters Point Ave. and Orton St. Estimated cost $1,000,000. Architect not selected.

N. Y., Port Ivory (mail Mariners Harbor) Proctor & Gamble, Sixth and Main Sts., Cincinnati, O., awarded contract for the construction of a factory, here, to J. W. Ferguson, 52 Market St., Paterson, N. J. Estimated cost $3,000,000.

Pa., Dunbar — Pennsylvania Wire Glass Co., Fifteenth and Chestnut Sts., Philadelphia, plans the construction of a 1 story, 60 x 144 and 70 x 144 ft. glass plant, here. Private plans.

Pa., Philadelphia — C. E. Johnson Co., 10th and Lombard Sts., plans the construction of a printing ink factory at Swanson and Porter Sts. E. G. Perrot, 1211 Arch St., is architect.

Pa., Philadelphia—C. E. Wunder, 1520 Locust St., Archt., will receive bids until Feb. 23 for the construction of a 4 story, 60 x 100 ft. pharmacal factory at 17th and Cambria Sts., for R. McNeil, 2347 Reese St. Estimated cost $150,000.

Pa., Pittsburgh—Lustro Coated Sheet Co., 1312 Sheffield St., awarded contract for the construction of a 1 story, 100 x 200 ft. manufacturing plant on Ridge Ave., to The Austin Co., Union Trust Bldg. Estimated cost $50,000.

South

Ala., Gadsden — Southern Gas & Power Co. is having surveys made for improvements and extensions to gas plant. Sanderson & Porter, 52 William St., New York, N. Y., are engineers.

Fla., Daytona Beach — K. V. Corp., 302 South Beach St., is in the market for machinery for the manufacture of fire brick, floor and roofing tile.

Fla., Tampa — Tampa Thermaline Gas Corp., c/o L. Wolf, Chemical Engr., now being organized, plans the construction of a chemical plant at Seaboard Air Line Ry. Estimated cost $250,000.

Fla., Tulford—Kelbay Corp., 342 Madison Ave., New York, N. Y., plans the construction of a cement plant, 25,000 block cement daily capacity, here. Estimated cost $100,000.

Tenn., Nashville—Victor Chemical Co., Centennial Blvd., manufacturers of phosphate for baking powder, award contract for the construction of first unit to plant to replace fire loss to Foster-Creighton Co., Fourth and First National Bank Bldg. $50,000. Contracts for other units will be awarded later. Total estimated cost $500,000.

Middle West

Ind., Hammond — The Paige & Jones Chemical Co., has work under way on additions to plant to double the capacity.

Ind., Indianapolis—Lilly Varnish Co., C. M. Malott, Pres., awarded contract for the construction of a 3 story factory to Mothershead & Fitton, 540 North Meridian St. Estimated cost $45,000.

Ind., Indianapolis—Swan-Myers Co., 219 North Senate St., awarded contract for the construction of a 4 story, 66 x 128 ft. chemical laboratory to Cornell Engineering Co., 2611 Cornell Ave. Estimated cost $150,000.

Ind., Indianapolis—Standard Nut Margarine Co., G. Sonnich, Pres., is having plans prepared for the construction of a 3 story, 50 x 60 ft. factory at Roosevelt and Lewis Sts. Estimated cost $50,000. R. N. Edwards, 71st and Pennsylvania Sts., is architect.

O., Cleveland—Acme Artificial Silk Co., C. P. Green, Gen. Mgr., 1294 West 70th St., awarded contract for the construction of a 1 story, 31 x 110 ft. addition to factory to W. J. Pierik, 7016 Euclid Ave. Estimated cost $40,000.

O., Cleveland—Federal Cement Co., L. A. Beeghly, Pres., Wick Bldg., Youngstown, plans the construction of a plant along the Cuyahoga River here. Estimated cost $2,000,000.

O., Cleveland—The Ferbert-Schorndorfer Co., A. J. Schorndorfer, Pres., Berea Road, manufacturers of paints and varnishes, awarded contract for the construction of a 2 story, 50 x 130 ft. addition to office, laboratory and factory to The Austin Co., 16112 Euclid Ave. Estimated cost $100,000.

O., Cleveland—The Universal Portland Cement Co., 210 La Salle St., Chicago, Ill., has acquired a site and plans the construction of a plant along the Cuyahoga River here. Estimated cost $2,000,000.

O., Zanesville—Mosaic Tile Co., awarded contract for the construction of 1 story, 120 x 180 and 150 x 180 ft. factory buildings to H. K. Ferguson Co., 4900 Euclid Ave. Estimated cost $150,000.

Wis., Milwaukee—Plastic Products Co., 23 Reservoir Ave., awarded contract for the superstructure of a 2 story, 76 x 200 ft. factory on Port Washington Road to Lupinski & Wolff, 82 Wisconsin St.

Wis., Milwaukee — Red Star Yeast & Products Co., 79 Buffalo St., is having plans prepared for the construction of a 3 story, 52 x 100 ft. dry house on 27th St. Estimated cost $75,000. E. R. Seibert, 49 Oneida St., is architect. Conveyors, refrigeration machinery, etc., will be required. Contract for the construction of a 2 story, 52 x 70 ft. addition to engine and blower house was awarded to Universal Construction Co., 915 Chestnut St. Estimated cost $50,000.

West of Mississippi

Ark., Norphlet — Natural Gas & Fuel Corp., E. Dorado, is having preliminary plans prepared for the construction of a gasoline absorption plant. Estimated cost $300,000. Private plans.

Colo., Rifle—Vanadium Mill, G. Kunkle, Pres., plans to expend $250,000 for extensions to mill to increase the capacity from 100 to 120 tons daily.

Ia., Cedar Rapids — Waconia Sorghum Mills Inc., E. Wessale, Pres., Waconia, Minn., is receiving bids for the construction of a group of buildings, here. Machinery including vacuum evaporators, filters, pumps, tanks, etc., will be required.

Ia., Oskaloosa—Standard Clay Products Co., T. J. Neiswanger, Pres., will build an addition to brick plant by day labor. Estimated cost $50,000. Private plans.

Mo., Marionville — Speas Vinegar Mfg. Co., Nicholson and Watkins Sts., Kansas City, plans the construction of a factory, here. Estimated cost $75,000. Architect not selected.

Mo., Mexico — Western Stove Lining Works, plans the construction of addition to kiln plant. Estimated cost $25,000.

Okla., Bristow—Blue Diamond Glass Co., Third and Elm Sts., awarded contract for the construction of a 30 x 60 ft. plant to Gantz Tank Co., Sapulpa. Estimated cost $8,000. Company engineers in charge. Owner is taking bids on automatic crimping machines, chemicals, sand boxes, etc.

Okla., Enid—Bolene Refining Co., V. E. Bolene, Pres., had plans prepared for rebuilding and enlarging oil refinery including additional stills and cracking vats. Estimated cost $300,000.

Okla., Okmulgee—Independent Oil & Gas Co., c/o Commerce Investment Co., is having preliminary plans prepared for extensions to plant including 1,000 bbl. Jenkins cracking still and contact filtering system, etc. Estimated cost $150,000. Company engineers in charge.

Tex., Port Arthur—Gulf Refining Co., plans the construction of 20 high pressure gasoline stills. Estimated cost $1,500,000. Equipment will be required. Work will be done by owner's forces.

Tex., Rockdale — Kent - Middleton Co., Rockdale, and Hirt-McDermott Co., Wichita Falls, are having preliminary plans prepared for the construction of a casinghead gas plant near here. Estimated cost $50,000.

Tex., Yoakum—A. Strunk & Associates, recently organized, plans the construction of a candy factory. Estimated cost $25,000. Machinery will be required.

Far West

Calif., King City—Nestles Food Co., 112 Market St., San Francisco, plans the construction of a milk condensary here. Estimated cost $200,000.

Calif., Redwood City — Plant Rubber & Asbestos Co., 537 Brannan St., San Francisco, plans the construction of a factory to replace fire loss here. Estimated cost $200,000. Architect not selected.

Canada

Ont., Fergus—Beatty Bros., wants prices and data on equipment for proposed 72 x 134 ft. galvanizing department. Estimated cost $25,000.

Ont., Kapuskasing—Spruce Falls Pulp & Paper Co. is having plans prepared for the construction of a newsprint mill, 400 to 500 ton daily capacity here, also a hydro-electric plant on the Mattagami River at Smoky Falls. Estimated cost $10,000,000. G. F. Hardy, 305 Broadway, New York, N. Y., is engineer.

Ont., Toronto—Bd. of Education, 155 College St., plans the construction of a 3 story technical school including chemical laboratory, etc. Total estimated cost $1,000,000. C. E. Dyson, 155 College St., is architect. Equipment will be required.

Ont., Windsor—Canadian Salt Co., G. M. Duck, Gen. Mgr., plans the construction of extensions to plant. Estimated cost $500,000. Special equipment for pumping, refining and handling salt will be required.

Que., Cap-de-la Madeleine—St. Maurice Valley Co. had plans prepared for changing pulp digester. Estimated cost $40,000. S. W. Slater is engineer.

Que., Drummondville — Canadian Cellulose & Chemical Co., subsidiary of the American Cellulose & Chemical Co., 15 East 26th St., New York, N. Y., plans the construction of a plant here. Estimated cost $7,000,000.

Que., Jonquieres—Price Bros. Co. Ltd., plans the construction of a mill to house paper and cardboard machines. Estimated cost $150,000. A Duehastel de Montague, is architect.

Que., Quebec City—Gulf Pulp & Paper Co., 71 St. Peter St., plans the construction of a paper mill. G. Hardy, 309 Broadway, New York, N. Y., is engineer.

Que., Shawenegan Falls—Canadian Carborundum Co. plans extensions to plant. Estimated cost $500,000. R. A. Whiterspoon is engineer.

Que., Shawenegan Falls — St. Maurice Valley Corp. plans the construction of 2 new units to paper mill. Estimated cost $2,500,000. H. Sorgius is engineer.

Que., Sorel—Quebec Industrial Alcohol Ltd. has work under way on the construction of two molasses tanks, 5,000 gal. capacity each, and proper outfit to pump molasses from wharf in the tank. Estimated cost $35,000.